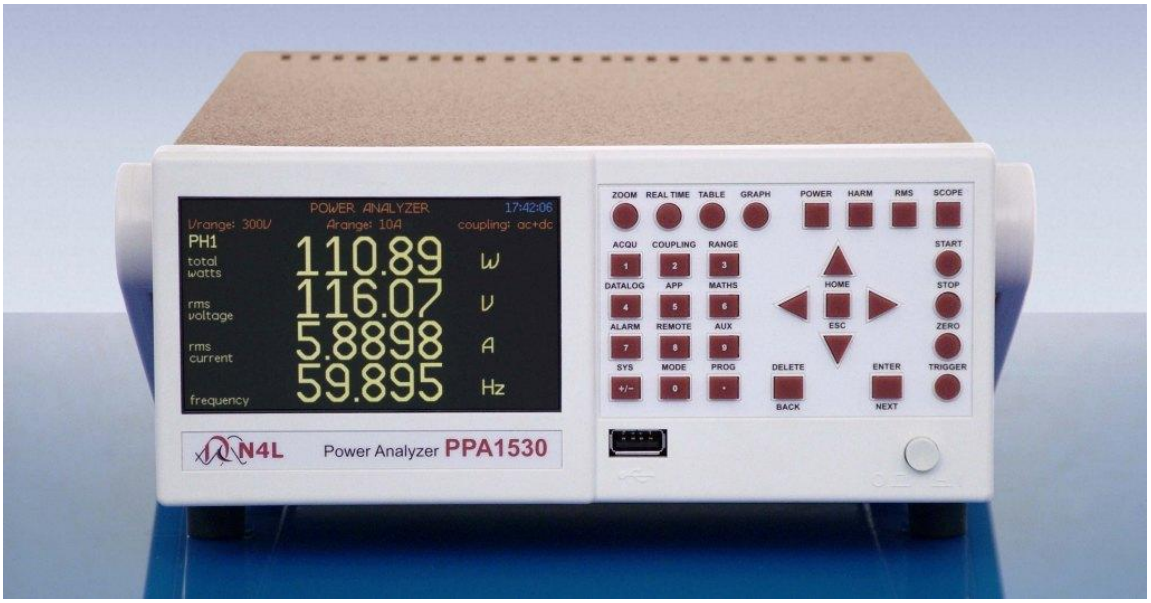
Newtons4th Ltd

PPA500/1500

KinetiQ

USER MANUAL



Firmware v2.54

18th March 2015

DANGER OF ELECTRIC SHOCK
Only qualified personnel should install this equipment, after reading and understanding this user manual. If in doubt, consult your supplier.

RISQUE D'ELECTROCUTION
L'installation de cet équipement ne doit être confiée qu'à un personnel qualifié ayant lu et compris le présent manuel d'utilisation. Dans le doute, s'adresser au fournisseur.

GEFAHR VON ELEKTRISCHEM SCHOCK
Nur entsprechend ausgebildetes Personal ist berechtigt, diese Ausrüstung nach dem Lesen und Verständnis dieses Anwendungshandbuches zu installieren. Falls Sie Zweifel haben sollten, wenden Sie sich bitte an Ihren Lieferanten.

RISCHIO DI SCARICHE ELETTRICHE
Solo personale qualificato può installare questo strumento, dopo la lettura e la comprensione di questo manuale. Se esistono dubbiconsultate il vostro rivenditore.

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Solo personal cualificado debe instalar este instrumento, después de la lectura y comprensión de este manual de usuario. En caso de duda, consultar con su suministrador.

IMPORTANT SAFETY INSTRUCTIONS

This equipment is designed to comply with BSEN 61010-1 (2001) (Safety requirements for electrical equipment for measurement, control, and laboratory use) – observe the following precautions:

- Ensure that the supply voltage agrees with the rating of the instrument printed on the back panel ***before*** connecting the mains cord to the supply.
- This appliance ***must*** be earthed. Ensure that the instrument is powered from a properly grounded supply.
- The inputs are rated at 1kV rms or dc cat II; 600V rms or dc cat III. **Do not exceed the rated input**.
- Keep the ventilation slots in the top and sides of the cover free from obstruction.
- Do not operate or store under conditions where condensation may occur or where conducting debris may enter the case.
- There are no user serviceable parts inside the instrument – do not attempt to open the instrument, refer service to the manufacturer or his appointed agent.

Note: Newtons4th Ltd. shall not be liable for any consequential damages, losses, costs or expenses arising from the use or misuse of this product however caused.

DECLARATION OF CONFORMITY

Manufacturer: Newtons4th Ltd.
Address: 1 Bede Island Road
Leicester
LE2 7EA

We declare that the product:

Description: Power Analyser

Product name: KinetiQ

Model: PPA5xx/15xx Family

conforms to the requirements of Council Directives:

89/336/EEC relating to electromagnetic compatibility:
EN 61326:1997 Class A

73/23/EEC relating to safety of laboratory equipment:
EN 61010-1

Oct 2012

Eur Ing Allan Winsor BSc CEng MIEE
(Director Newtons4th Ltd.)

WARRANTY

This product is guaranteed to be free from defects in materials and workmanship for a period of 36 months from the date of purchase.

In the unlikely event of any problem within this guarantee period, first contact Newtons4th Ltd. or your local representative, to give a description of the problem. Please have as much relevant information to hand as possible – particularly the serial number and release numbers (press SYSTEM then LEFT).

If the problem cannot be resolved directly then you will be given an RMA number and asked to return the unit. The unit will be repaired or replaced at the sole discretion of Newtons4th Ltd.

This guarantee is limited to the cost of the instrument itself and does not extend to any consequential damage or losses whatsoever including, but not limited to, any loss of earnings arising from a failure of the product or software.

In the event of any problem with the instrument outside of the guarantee period, Newtons4th Ltd. offers a full repair and re-calibration service – contact your local representative. It is recommended that the instrument be re-calibrated annually.

ABOUT THIS MANUAL

This manual describes the general features, usage and specifications of the KinetiQ PPA5xx/15xx range of power analysers.

Detailed descriptions of the communications command set for RS232, USB and LAN (where fitted) is given in the separate document: PPA5xx/15xx Communications Manual.

PPA5xx/15xx Firmware revision 2.54 (18th March 2015)

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1 Introduction – general principles of operation

KinetiQ is a sophisticated and versatile power analyser for accurate wide-bandwidth power measurements.

The PPA5xx/15xx family of power analysers covers 1 to 3 phase applications in both low current and high current models.

Each phase input has wide ranging voltage and current channels which are fully isolated from each other and from ground. The voltage input has a built in high voltage attenuator or may be used with an external attenuator. The current input has a built in current shunt or may be used with an external shunt.

The voltage and current inputs are simultaneously sampled and the data is analysed in real time by a high speed DSP (digital signal processor). A separate CPU (central processing unit) takes the DSP results for display and communications. At the heart of the system is an FPGA (field programmable gate array) that interfaces the various elements.

This powerful, versatile structure allows the measurement of a wide range of power related parameters including:

W, VA, VAr, power factor, phase
true rms, fundamental
harmonics, TIF
integrated values (W hours etc.)
impedance
inrush current, voltage surge
oscilloscope (PPA15xx only)

KinetiQ is particularly easy to use, with a large clear colour display and single menu levels for all main parameters. Even difficult applications such as lighting ballasts can be

easily addressed with the special modes application in the firmware of the instrument.

The whole operation of the instrument may be controlled remotely via a serial interface (RS232/USB), or optionally a LAN interface.

The voltage and current channels are identical except for the voltage attenuator and current shunt at the very front end.

Each channel consists of a selection switch for external or internal attenuator/shunt followed by a high impedance buffer, then a series of gain stages leading to an A/D converter. Selection of the input gain and the sampling of the A/D converter are under the control of the DSP. There is an autozero switch at the front end for dc accuracy. The analogue circuitry is optimised for high linearity over a wide dynamic range and high frequency performance.

The PPA5xx/15xx includes an “internal - x10” mode which adds a x10 gain stage to the analogue amplifier chain. This allows measurement of even smaller signals with the caveat that the bandwidth is reduced to c. 100 kHz.

Both input channels are fully isolated with very good CMRR and noise rejection.

The current shunt is of a proprietary design which gives very wide bandwidth with minimum phase shift.

The voltage attenuator is of a proprietary design which has a wide bandwidth response matched to that of the current shunt.

Both the voltage and current channels are calibrated digitally so there are no physical adjustments to be made.

2 Getting started

KinetiQ is supplied ready to use – it comes complete with an appropriate power lead and a set of test leads. It is supplied calibrated and does not require anything to be done by the user before it can be put into service.

2.1 Unpacking and power-up

Inside the carton there should be the following items:

one KinetiQ unit
one appropriate mains lead
one red, one yellow and two black 4mm leads per phase
one red, one yellow and two black crocodile clips per phase
one null modem cable
one USB cable
Communications manual
User manual (this manual)

Before connecting the test leads to an active circuit first connect the mains cord from a properly grounded supply outlet to the inlet on the rear panel of the KinetiQ. KinetiQ has a universal mains input and accepts any supply voltage from 90-265Vrms at 50 or 60Hz.

Note: If the power is cycled “off-on” within a 10 second time period, the message “Turn power off for 10 seconds” appears. A 10 second power off window allows all micro controllers to fully reboot and prevents any errors during the power on sequence.

Switch on the KinetiQ. The display should illuminate with the model name and the firmware version for a few seconds while it performs start-up checks. It should then

default to the power measurement display. Note that the switch-on message can be personalised – see the User Data section under System Options.

The screen is a 4.3” (110mm) LCD colour display. There are no manual adjustments as the display should be clear and visible in all lighting applications.

Allow 30 minutes warm up time before commencing any tests to ensure accurate readings.

The voltage and current leads may now be connected to a circuit under test. The high common mode rejection ratio (CMRR) of the instrument allows the current channel to be connected in the live path (high side shunt) instead of the neutral path (low side).

The test leads supplied meet the safety requirements of BSEN61010-1 to an operating voltage of up to 1000V rms cat II or 600V rms cat III.

The Quick Start guide, Section 3 below, gives an introduction to the operating modes of the KinetiQ, and the selection of options and parameters. The Quick Start guide may be followed with no inputs connected to the instrument.

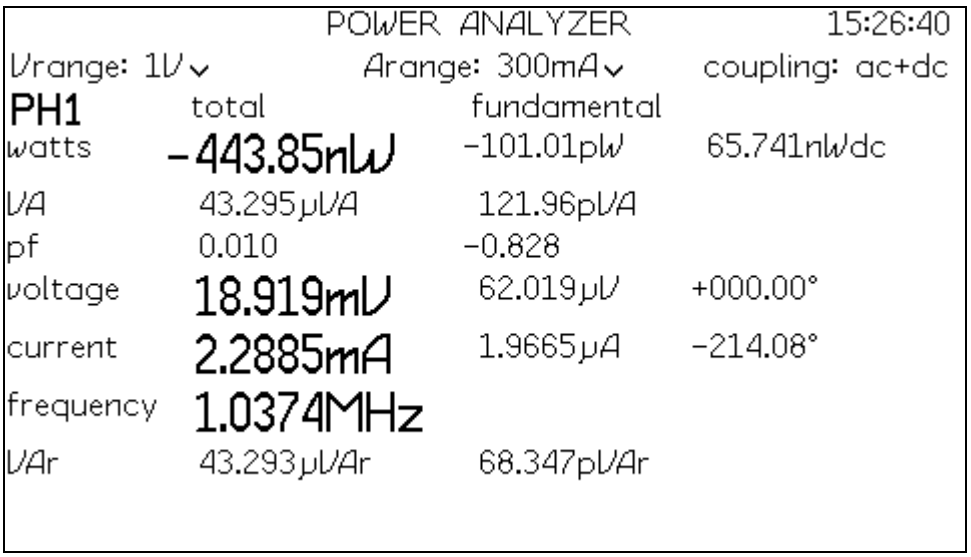
In the event of any problem with this procedure, please contact customer services at Newtons4th Ltd. or your local authorised representative; contact addresses and telephone numbers are given in the appendix at the back of this manual.

3 Quick Start guide

3.1 Operating Mode Keys

Operating Mode selection

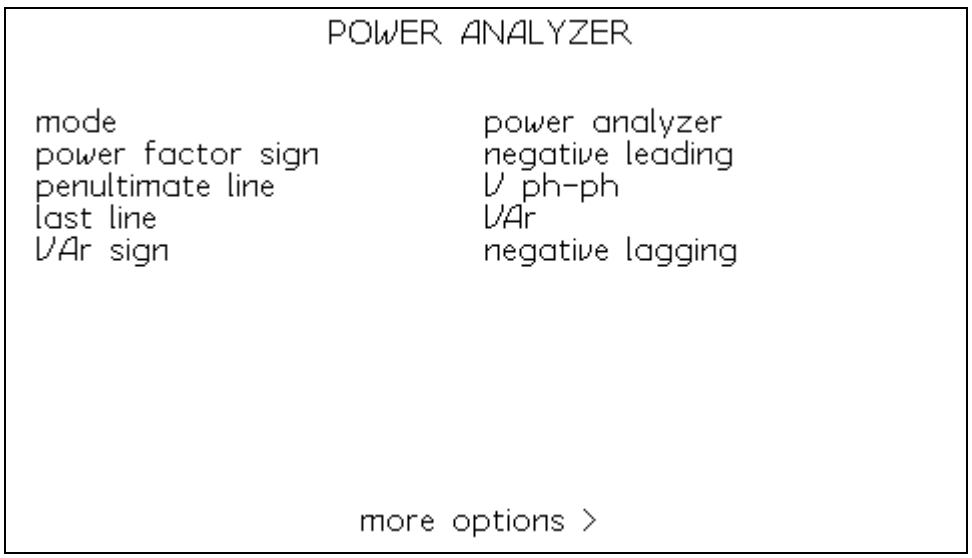
(Power-on default is Power Analyzer – diagram below shows single-phase display. Note that with no inputs connected, display will be showing noise levels only.)



Press the POWER, HARM, RMS, or SCOPE (PPA15xx only) keys to access the operating modes directly, (other modes are available via the MODE menu – see below).

Select Menu Options

Press the Operating Mode key, e.g. POWER, a second time, or press the MODE key, to access mode-specific options (diagram below shows *Power Analyzer* options).



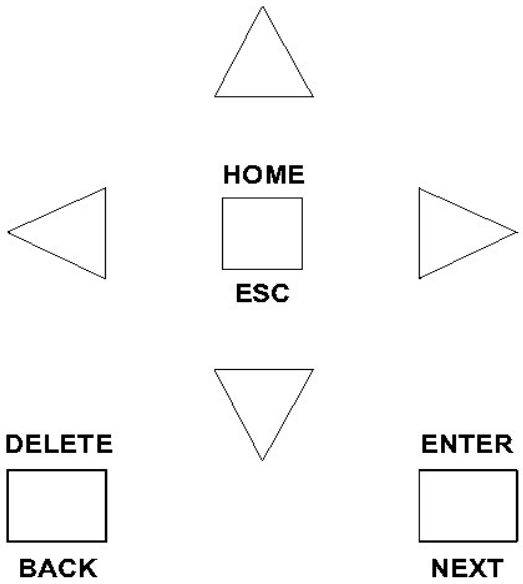
Use UP and DOWN keys to highlight option, and ENTER to confirm (see para. 3.2 Menu Control Keys). Parameter values within the selected option may be adjusted using the L or R keys or by entering a numeric value directly, as indicated. Press ENTER to confirm.

With **operating mode** highlighted, use the L and R keys to cycle through operating modes and to access *Phase Meter* mode.

Use ENTER or HOME to return to readout display.

For text entry see 3.7 Data Entry Guide.

3.2 Menu Control Keys



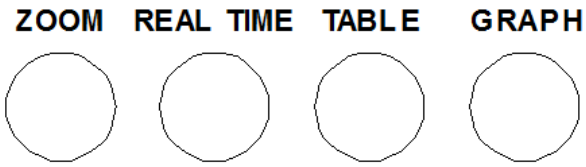
ENTER / NEXT confirms your selection or parameter value/data entry.

HOME / ESC returns to the original entry or to your previous action.

DELETE / BACK removes a previous selection or value, or returns to your previous action.

ARROW KEYS (UP, DOWN, L, R) move around menu options; make incremental/decremental changes etc. They are also used to position cursors in *Scope* mode.

3.3 Display Control Keys



PPA15xx

ZOOM - up to 4 displayed values may be emphasized.

a. Press ZOOM to display data in zoom level 2.

b. Press ZOOM twice more to move through zoom level 3 to no zoom.

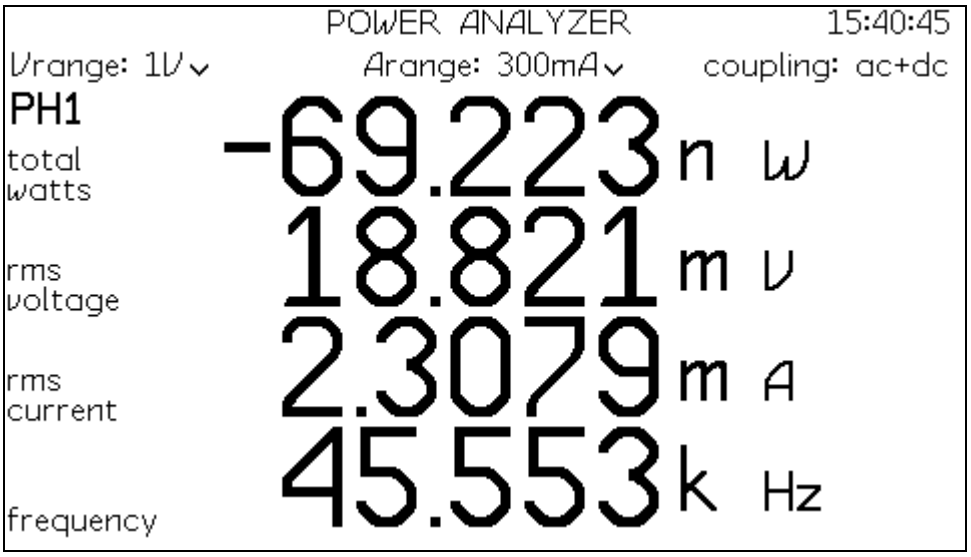
c. Press DELETE to clear the selection.

d. Position the flashing box over the data to be emphasized using the UP, DOWN, L and R menu control keys.

e. Press ENTER to confirm (*flashing stops).*

f. Continue to select up to a total of 4 values.

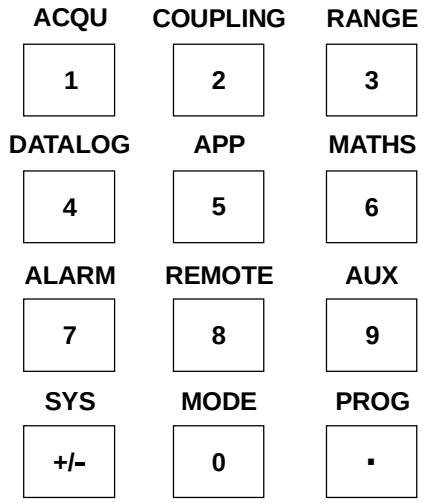
g. Press ZOOM to display emphasized values as desired.
(Diagram below shows top zoom level for *Power Analyzer.*)



REAL TIME toggles between continuous display readings and holding an instantaneous reading on screen. *Note: measurements continue to be taken even when display is in Hold.*

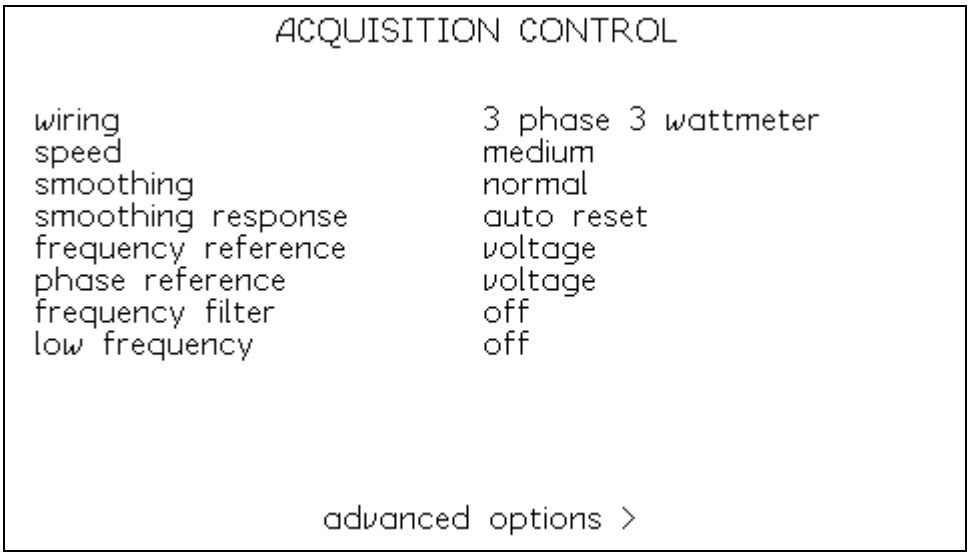
TABLE, GRAPH selects tabular or graphical presentation of data as collected in DATALOG (see 3.4 Setup Keys), or in *Harmonic Analyzer* mode. (Graph only available in PPA15xx series)

3.4 Setup Keys/Keypad



SELECT MENUS for non mode-specific configuration. Also use as numeric keypad when entering parameter values or data.

ACQU – use for configuring inputs appropriate to the source and nature of signals being analyzed. (Diagram below shows *Power Analyzer* default setup.)



COUPLING – appropriate to input signals.

RANGE – configure according to magnitude (voltage and current) of input signals.

DATALOG – only available for *Power Analyzer* and *True RMS Voltmeter* modes; sampling interval and storage location. Datalog is disabled by default. (See also TABLE, GRAPH in 3.3 Display Control Keys.)

APP – application-specific measurements, e.g. inrush current.

MATHS – a choice of three formulae – functions of up to four measurements.

ALARM – audible/visual indication of thresholds crossed set by ZOOM values (see 3.3 Display Control Keys). Default is Alarm disabled.

REMOTE – configure external comms.

AUX – Phase-Controlled Inrush Switch control.

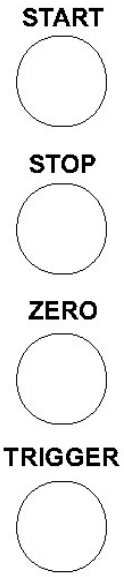
SYS – configure general system features.

MODE – see 3.1 Operating Mode Keys.

PROG – save, recall or delete Mode, Display and Setup configurations for user-defined applications. Recall data saved in DATALOG (see DATALOG key above).

For numeric entry see 3.7 Data Entry Guide.

3.5 Control Keys



START & **STOP** datalog function (when enabled) or integration (*Integ* mode). Either key also triggers single-shot in *Scope* mode.

Use **ZERO** key for:

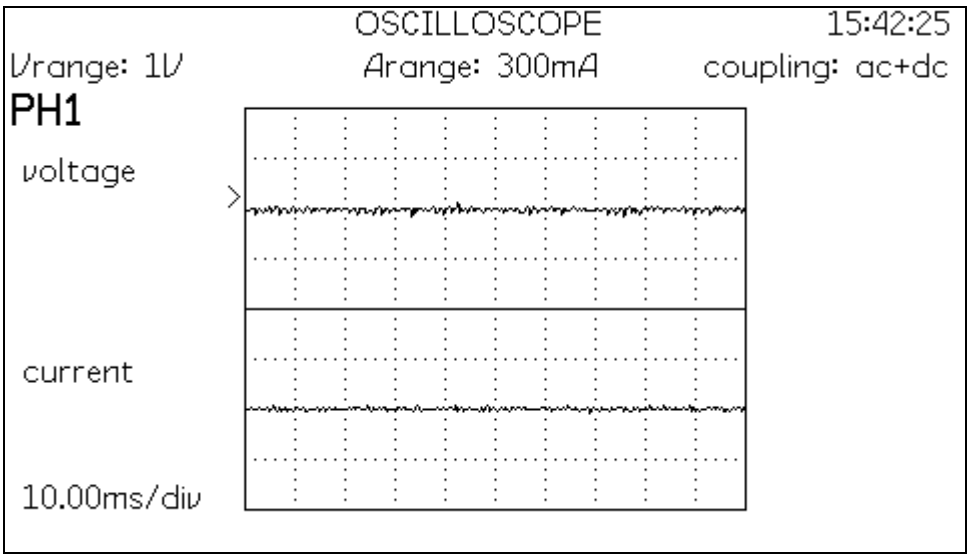
a. Zero compensation of input amplifier chain.

b. Reset integrator to zero (*Integ* mode).

TRIGGER (or **START)** returns display to Real Time from Hold. It also arms single-shot triggering in *Scope* mode.

3.6 Scope Mode (PPA15xx only)

Selecting *Scope* mode from the operating mode keys, or by cycling through the operating modes in any of the operating mode select options, displays voltage and current waveforms as a conventional oscilloscope – diagram below shows the default display with no inputs connected.

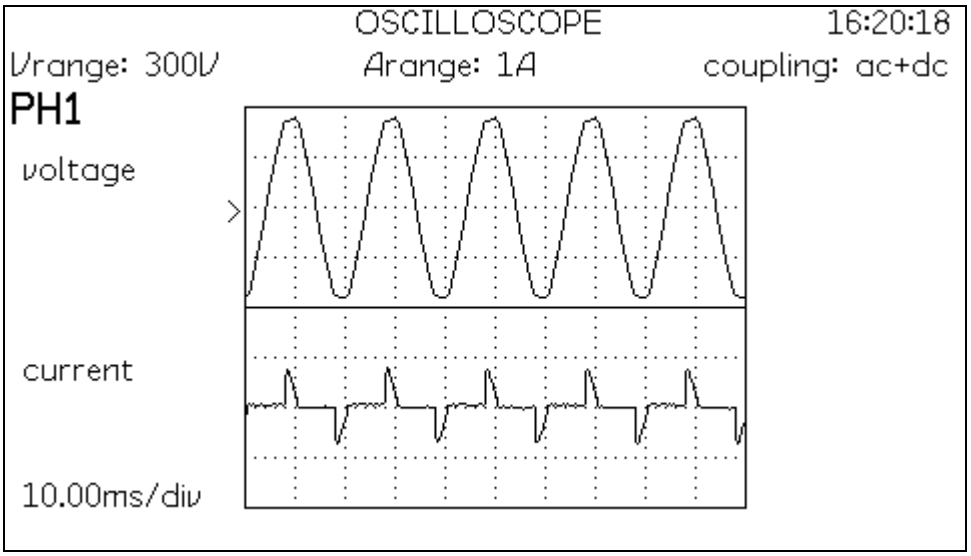


The following diagram shows the options available in *Scope* mode:

MEASUREMENT SETTINGS

mode	oscilloscope
timebase	10.00ms/div
trigger reference	voltage
trigger level	+200.0mV
trigger mode	auto
trigger polarity	rising edge
trigger HF reject	off
pretrigger	25%
cursors	off
trace	dual

A typical display of voltage and current waveforms for a switched mode power supply is shown below:



When operating in *Scope* mode, the L and R control keys operate in one of two ways:

A. With the cursor option ‘off’ (default), the L and R control keys change the timebase.

B. With the cursor option ‘on’ the L and R control keys change the cursor position and the UP and DOWN keys toggle between cursor 1 control and cursor 2 control.

When cursors are enabled, the scope screen will display the following parameters; Vrms, Vpk, Watts, pf, Arms, Apk

3.7 Data Entry Guide

Text Entry

Use MODE key to select text entry. Enter text via the 4 function keys in the upper right of the panel. Each function key jumps to a different letter of the alphabet:

(POWER) **A**, (HARM) **I**,
(RMS) **O**, (SCOPE) **space**

Choose other characters by stepping forward or backward using the UP and DOWN keys. Select upper/lower case with the ZOOM key.

(Values may be overwritten or edited by use of the L, R and DELETE keys)

Alternatively text entry can be made via the numerical keypad resembling a telephone keypad, where key 1 is symbols, key 2 ABC, key 3 DEF etc.

Numeric Entry

Use MODE/numeric keys for number, decimal point, or +/– to enter parameter value. The 4 function keys in the upper right of the panel may be used as quick multipliers, where

POWER is 10^{6} (M), HARM is 10^{3} (k), RMS is 10^{-3} (m), and SCOPE is 10^{-6} (µ).

Press ENTER (menu control keys) to set value.

Press HOME (menu control keys) to abort data entry, restore original.

(Values may be overwritten, or edited by use of the R, L and DELETE keys)

4 Using the menus

KinetiQ is a very versatile instrument with many configurable parameters. These parameters are accessed from the front panel via a number of menus.

Each of the main menus may be accessed directly from a specific key.

ACQU	data acquisition parameters such as speed and filtering
COUPLING	select ac/dc coupling
RANGE	select input ranges, and scaling
DATALOG	specify datalog parameters
APP	Application specific functions
MATHS	User defined computations
ALARM	control of audible alarm
REMOTE	communications options (RS232 etc)
AUX	control of auxiliary devices connected to the rear EXTENSION and AUX ports
SYSTEM	general system options such as phase convention, keyboard beep etc.
MODE	function control
PROG	recall/store/ delete of programs and datalog

Each menu starts with the currently set parameters visible but no cursor. In this condition, pressing the menu key again or the HOME key aborts the menu operation and reverts to normal operation.

To select any parameter, press the UP or DOWN key and a flashing box will move around the menu selecting each parameter. In this condition the keys take on their secondary function such as numbers 0-9 etc.

Pressing the HOME key reverts to the opening state where the parameters are displayed but the cursor is hidden.

Pressing the HOME key again exits the menu sequence and reverts to normal operation.

To abort the menu sequence, press the HOME key twice.

There are three types of data entry:

selection from a list
numeric
text

4.1 Selection from a list

This data type is used where there are only specific options available such as the smoothing may be ‘normal’, ‘slow’, or ‘none’, the graph drawing algorithm may use ‘dots’ or ‘lines’.

When the flashing cursor is highlighting the parameter, the R key steps forward through the list, and the L key steps backwards through the list. The number keys 0-9 step directly to that point in the list, which provides a quick way to jump through long lists. There is no need to press the ENTER key with this data type

For example, if the smoothing selection list comprises the options:

normal
(item 0)
slow
(item 1)
none
(item 2)

and the presently selected option is normal, there are 3 ways to select none:

press R twice
press L once
press number 2

4.2 Numeric data entry

Parameters such as external shunt impedance and scale factor are entered as real numbers; shunt impedance is an example of an unsigned parameter, scale factor is an example of a signed parameter.

Real numbers are entered using the number keys, multiplier keys, decimal point key, or +/- key (if signed value is permitted). When the character string has been entered, pressing the ENTER key sets the parameter to the new value. Until the ENTER key is pressed, pressing the HOME key aborts the data entry and restores the original number.

If a data value is entered that is beyond the valid limits for that parameter then a warning is issued and the parameter set as close to the requested value as possible. For example, the minimum user defined measurement window 10ms; if a value of 5ms is entered, a warning will be given and the amplitude set to the maximum of 10ms.

When the parameter is first selected there is no character cursor visible – in this condition, a new number may be entered directly and will overwrite the existing number.

To edit a data value rather than overwrite it, press the R key and a cursor will appear. New characters are inserted at the cursor position as the keys are pressed, or the character before the cursor position can be deleted with the DELETE key.

Data values are always shown in engineering notation to at least 5 digits (1.0000-999.99 and a multiplier).

4.3 Text entry

There are occasions where it is useful to enter a text string; for example, a stored program may have some text as a title.

Numbers and text can be inserted using the number keys which function similarly to a phone keypad.

The UP and DOWN keys step forward and backward using the ASCII character definitions – other printable characters such as # or ! can be obtained by stepping on from the space. The available character set is given in the Appendix.

When entering alphabetic characters, the PROG key toggles between upper and lower case for the character preceding the cursor and the next characters to be entered.

The editing keys, R, L, DELETE and ENTER operate in the same way as for numeric entry.

5 Special functions

5.1 Display zoom

KinetiQ normally displays many results on the screen in a combination of small font size (no zoom) and up to 4 values in a larger font size (first zoom level). There are two further zoom levels which can display up to four and up to three selected values respectively at larger font sizes (second and third zoom levels).

To set the data values for the larger font size, first return to no zoom by pressing ZOOM as many times as necessary. Press the ZOOM key to view the presently selected data, and press DELETE to clear the selection.

A flashing box surrounds the first available result. The flashing box is moved around the available results using the cursor keys, UP, DOWN, L and R. Pressing the ENTER key selects the result for zoom and the box ceases to flash. Further results (up to four in total) can then be selected using the cursor keys in the same way – a solid box remains around the already selected item, and a new flashing box appears.

Having selected the desired results, pressing the ZOOM key steps through the zoom levels until the highest is reached, at which point a further press returns to no zoom.

Note that any of the parameters selected for the zoom function can be used as the input for the alarm monitoring, and datalog.

5.2 PROG – store and recall

There are 3 types of data which can be saved:

Programs
Data log
Measurement results

There are 100 program locations where the settings for the entire instrument can be saved for recall at a later date. Each of the 100 locations has an associated name of up to 20 characters that can be entered by the user to aid identification.

Program numbers 1-4 may be recalled with a single press of the function keys if the direct load option is selected in the system menu (see system options).

The instrument can be restored to the factory default settings at any time by recalling program number 0. Any program saved to location 1 will automatically be loaded every time the instrument is restarted. The program menu is accessed using the PROG key. The program location can be selected either by stepping through the program locations in turn to see the name, or by entering the program number directly.

When storing a configuration in a program, there will be a short pause of about 1 second if the program location had previously been written or deleted. The process will be very quick if the location has not been used.

When supervisor mode is disabled (see system options), programs can only be recalled, not stored nor deleted, to avoid accidental modification.

When recalling a program it may be desirable for the program to recall the selected communications interface

that was in use when the program was stored (RS232 or USB etc). Alternatively it is more common for the communications interface to be associated with the instrument rather than a stored program. There is a selectable option in the REMOTE menu to enable the ‘recall with program’. If this is ‘off’ then recalling the program will not change the communications interface.

All file directory information can be displayed by pressing the PROG key and then the TABLE button. This will allow all the information to be displayed as a table and show what the internal file directory contains. (pressing the TABLE button again exits the directory).

Datalog can be stored directly onto a USB memory stick or logged to RAM and stored subsequently. The data then can be recalled for viewing or to download to a PC for further analysis.

Measurement results can be stored in one of 20 locations. Press REAL TIME to hold the results, press PROG and select memory = results. Each location holds the entire set of computed results for all the phases no matter what phase is on the display. Oscilloscope and harmonic series data can also be stored but these take 3 contiguous locations each because of the large amount of data. In each case the full instrument set up is stored with the data and recalled so that measurements may easily be repeated and verified.

When using a large capacity or slow USB memory device, all the data may not be transferred within the transfer time window. If this happens it will be recognised and a display caption appears to prompt the user to ‘press any key’ to terminate the transfer when completed.

5.3 Zero compensation

There are 2 levels of zero compensation:

1) Trims out the dc offset in the input amplifier chain.

2) Measures any remaining offset and compensates.

The trim of the dc offset in the input amplifier chain can be manually invoked with the ZERO key, or over the RS232 with the REZERO command. This dc offset trim measures the dc present while the autozero switch is active and applies an equal and opposite offset via a D/A converter so that the input range to the A/D is optimised.

The measurement of the remaining offset also happens when the offset is trimmed but is also repeated at regular intervals. This is to compensate for any thermal drift in the amplifier chain. The remaining DC offset is precisely measured and stored so that the measurements can be compensated by an appropriate algorithm in the instrument firmware.

Real time measurement is not possible while the autozero measurement is in progress so this repeated autozero function can be disabled via the SYSTEM OPTIONS menu.

5.4 ALARM - alarm function

KinetiQ has 2 independent alarms that can be used to generate an audible warning:

sound the alarm if the value exceeds a threshold
sound the alarm if the value is below a threshold
sound the alarm if the value is outside a window
sound the alarm if the value is inside a window

The values to which the alarms are applied can be any of the measurements selected for zoom. The alarm status is also available as a logic output via the communications.

The first alarm also has option to generate a variable sound changing linearly as the value changes between two thresholds.

To program an alarm, first select the functions for the zoom; up to four measurements can be selected for the display, the alarm is applied to any of them; then press ALARM to invoke the alarm menu:

select which of the zoom functions is to be used
select the type of alarm
set the upper limit (if appropriate)
set the lower limit (if appropriate)
select whether the alarm is to be latched
select whether the alarm sounder is enabled

If the alarm latch is selected then both alarms will continue to sound even if the value returns to within the normal boundaries. To clear the alarm, press HOME.

The alarm latch can also be set to HOLD the data so that an event can be captured. The data on the screen will be the measurement that first triggered the alarm condition.

The linear alarm option allows tests to be carried out even if it is not possible to see the display. Pressing ZERO in the alarm menu sets the upper and lower threshold to 4/3 and 1/3 of the measured value respectively. The repetition rate of the sounder then varies linearly as the value changes between these thresholds.

5.5 Data hold

When in real time display mode, the data on the display can be held at any time by pressing the REAL TIME key. When HOLD is activated the word HOLD flashes in the top right hand corner of the display.

Press the REAL TIME key again or the HOME key or START key to release HOLD; in this case, HOME and START do not have their normal functions. Changing mode also releases hold.

When HOLD has been activated, the DSP continues to sample, compute and filter the results but the data is ignored by the CPU. When HOLD is released the display is updated with the next available value from the DSP.

HOLD can also be triggered by a an alarm condition (see section 5.4 alarm function)

Using remote control

KinetiQ is fitted with RS232 serial communications port and a USB port as standard, and may have a LAN interface fitted as an option. All the interfaces use the same ASCII protocol with the following end of line terminators:

	Rx expects	Tx sends
RS232 USB LAN	carriage return (line feed ignored)	carriage return and line feed

All the functions of KinetiQ can be programmed via any of the interfaces, and results read back.
The commands are not case sensitive and white space characters are ignored (e.g. tabs and spaces). Replies from KinetiQ are always upper case, delimited by commas, without spaces.

Only the first six characters of any command are important – any further characters will be ignored. For example, the command to set the bandwidth is BANDWI but BANDWIDTH may be sent as the redundant DTH at the end will be ignored.

Fields within a command are delimited by comma, multiple commands can be sent on one line delimited with a semi-colon, e.g.

BANDWI,LOW;SPEED,SLOW

Mandatory commands specified in the IEEE488.2 protocol have been implemented, (e.g. *IDN?, *RST) and all commands that expect a reply are terminated with a question mark.

Data values returned by KinetiQ are in scientific notation, with a 5 digit mantissa by default.

There is also an option for higher speed data transfer by selecting resolution = ‘binary’ where each value is returned in 4 bytes, each of which has the msb set so that it will not be interpreted as an ASCII character.

byte 1	2’s complement signed exponent
byte 2	bit 6 = mantissa sign bit 5:0 = mantissa bits 19:14
byte 3	mantissa bits 13:7
byte 4	mantissa bits 6:0

When the msbs are stripped off and the bytes put together, there is 6 bit signed exponent, a mantissa sign bit and a 20 bit mantissa magnitude. The value then is given by:

Value = +/- 2^exponent x mantissa / 2^20

KinetiQ maintains an error status byte consistent with the requirements of the IEEE488.2 protocol (called the standard event status register) that can be read by the mandatory command *ESR? (see section 5.1).

KinetiQ also maintains a status byte consistent with the requirements of the IEEE488.2 protocol, that can be read by the mandatory command *STB? over RS232, USB or LAN (see section 5.2).

The LAN IP address defaults to auto-assigned (DHCP) but can be set manually by the REMOTE menu.

RS232 data format is: start bit, 8 data bits (no parity), 1 stop bit. Flow control is RTS/CTS (see section 5.2), baud rate is selectable via the REMOTE menu.

A summary of the available commands is given in the Appendix. Details of each command are given in the communications manual.

Commands are executed in sequence except for two special characters that are immediately obeyed:

Control T (20) – reset interface (device clear)
Control U (21) – warm restart

5.6 Standard event status register

PON		CME	EXE	DDE	QYE		OPC

bit 0 OPC (operation complete)
cleared by most commands
set when data available
bit 2 QYE (unterminated query error)
set if no message ready when data read
bit 3 DDE (device dependent error)
set when the instrument has an error
bit 4 EXE (execution error)
set when the command cannot be executed
bit 5 CME (command interpretation error)
set when a command has not been recognised
bit 7 PON (power on event)
set when power first applied or unit has reset

The bits in the standard event status register except for OPC are set by the relevant event and cleared by specific command (*ESR?, *CLS, *RST). OPC is also cleared by most commands that change any part of the configuration of the instrument (such as MODE or START).

5.7 Serial Poll status byte

		ESB	MAV	ALA	FDV		RDV

bit 0 RDV (result data available)
set when results are available to be read as enabled by DAVER

bit 2 FDV (fast data available (streaming))
set when data streaming results are available to be read as enabled by DAVER

bit 3 ALA (alarm active)
set when an alarm becomes active as enabled by ALARMER

bit 4 MAV (message available)
set when a message reply is waiting to be read

bit 5 ESB (standard event summary bit)
set if any bit in the standard event status register is set as well as the corresponding bit in the standard event status enable register (set by *ESE).

5.8 RS232 connections

The RS232 port on KinetiQ uses the same pinout as a standard 9 pin serial port on a PC or laptop (9-pin male ‘D’ type).

Pin	Function	Direction
1	DCD	in (+ weak pull up)
2	RX data	in
3	TX data	out
4	DTR	out
5	GND	
6	DSR	not used
7	RTS	out
8	CTS	in
9	RI	not used

KinetiQ will only transmit when CTS (pin 8) is asserted, and can only receive if DCD (pin 1) is asserted. KinetiQ constantly asserts (+12V) DTR (pin 4) so this pin can be connected to any unwanted modem control inputs to force operation without handshaking. KinetiQ has a weak pull up on pin 1 as many null modem cables leave it open circuit. In electrically noisy environments this pin should be driven or connected to pin 4.

To connect KinetiQ to a PC, use a 9 pin female to 9 pin female null modem cable:

1 & 6	-	4
2	-	3
3	-	2
4	-	1 & 6
5	-	5
7	-	8
8	-	7

5.9 RS232 printer

The RS232 port can also be connected to a serial printer for making a hard copy of any screen. When printing is enabled in the REMOTE menu then pressing START will commence a screen dump to the printer. The graphic protocol used is the ESC/P so any printer which supports this protocol should work, e.g. the Seiko DPU-414.

The other communication options, USB or LAN, can still be used while the RS232 printer is enabled.

6 System options

Press SYS to access the system options.

The KinetiQ's real-time clock can be set to the current date and time.

The display brightness may be set to "low" or "high" depending on viewing conditions.

Measurements of phase can be expressed in one of three conventional formats:

-180° to +180° (commonly used in circuit analysis)
0° to -360° (commonly used in power applications)
0° to +360°

The measurement is exactly the same it is only the way that it is expressed that changes.

Each key press is normally accompanied by an audible 'beep' as well as the tactile 'click'. The 'beep' can be disabled for quiet environments if the feel of the key is sufficient feedback

Regular autozero measurements can be suppressed.

The 4 main function keys, POWER, HARM, RMS, SCOPE, can be used to load stored configurations as a "one-touch" way of configuring the instrument for specific applications. This is particularly useful in a production environment where an operator has a small number of specific tests to perform.

Independent ranging control for multi-phase instruments can be switched on or off.

Pressing R from the SYSTEM OPTIONS menu selects the USER DATA screen where up to three lines of user specified text may be entered. These are displayed on power up and may be read remotely by the command USER? to identify the instrument.

Pressing L from first SYSTEM OPTIONS menu displays the serial numbers, manufacture code, release versions, and calibration dates. These cannot be changed by the user.

6.1 User data

KinetiQ can be personalised by entering up to 3 lines of user data as text (see section on text entry).

User data is displayed every time that the instrument is switched on to identify the instrument. The entered text may also be read over the communications to identify the instrument (see USER?).

Typical arrangement of the user data might be:

line 1 company name
line 2 department or individual name
line 3 unique identifying number (eg. asset number)

Any user data may be entered as required, as the lines are treated purely as text and are not interpreted by KinetiQ at all.

After changing the user data, execute ‘store’ to save the data in non-volatile memory.

For use in a production environment, KinetiQ supports two modes of operation, supervisor and user. When supervisor mode is disabled, the stored programs can only be recalled, not changed. KinetiQ saves the mode of operation with the user data so that it may be configured to power up in either mode as required.

7 Measurement options

7.1 Wiring configuration

Unlike the single phase version of KinetiQ, PPA1510, the three phase version PPA1530 can be used in a variety of wiring configurations.

configuration	1530/ 530	1520/ 520	1510/ 510
single phase 1	✓	✓	✓
2 phase	✓	✓	
3 phase 2 wattmeter	✓	✓	
3 phase 3 wattmeter	✓		
single phase 2	✓	✓	
single phase 3	✓		
3 phase 2 wattmeter + phase 3	✓		

In the single phase modes (phase 1, phase 2, phase 3) the other phase inputs are completely ignored and the selected phase acts as a completely independent single phase power analyser.

In the 3 phase 2 wattmeter configuration, the voltages are measured relative to phase 3. The phase 1 voltage input is connected across phase 1 and phase 3, and phase 2 voltage input is connected across phase 2 and phase 3, thus measuring phase to phase voltage directly. Phase 1 and 2 current inputs are connected normally. There is no need to measure the current in phase 3 as phase 3 has no voltage relative to itself so the power contribution is zero. In this mode, the neutral channel displays the synthesised phase 3 current.

The advantage of this connection method is that 3 phase power can be measured with only 2 wattmeters. This frees up phase 3 of a 3 phase instrument to simultaneously measure the power of a single phase input (3 phase 2 wattmeter + phase 3 configuration). This allows direct measurement of efficiency in a 3 phase motor drive or 3 phase inverter application. The frequency reference for the independent phase 3 may be selected to be voltage, current, the mains line frequency, or the same as phase 1 & 2. In this mode, frequencies up to 1kHz can be measured with phase 3.

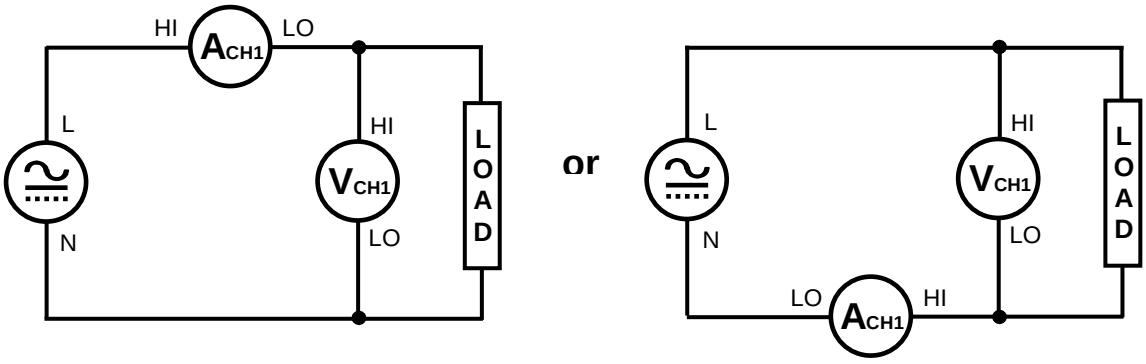
The 3 phase 2 wattmeter + phase 3 configuration can be used as an additional Torque & Speed application to supplement the existing “EXT” BNC connections on the rear panel.

With the 3 phase 3 wattmeter configuration, each measurement phase is connected to a phase of the load with the voltage inputs measuring to neutral. In this mode, phase to neutral voltages are measured directly and phase to phase voltages are also computed.

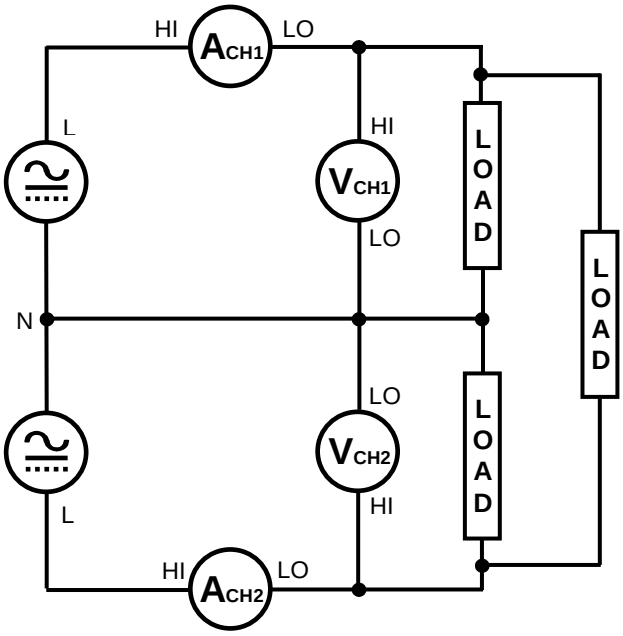
The wiring configuration is the first item to be selected under the ACQU menu.

7.1.1 Wiring diagrams

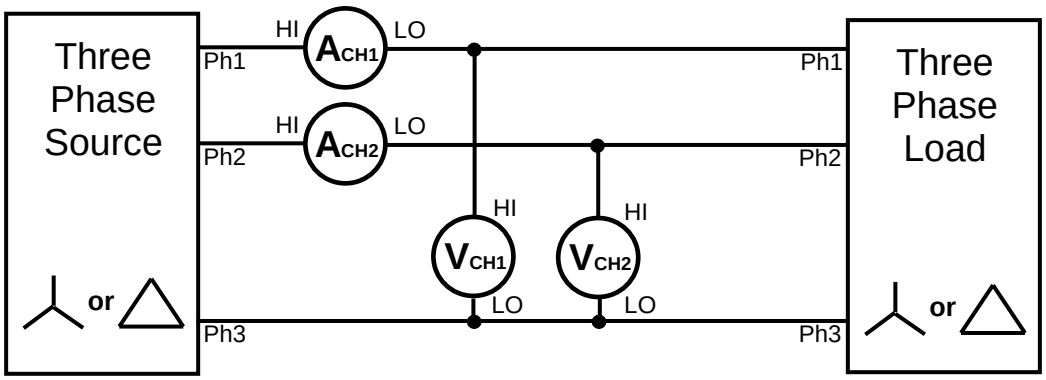
Single Phase



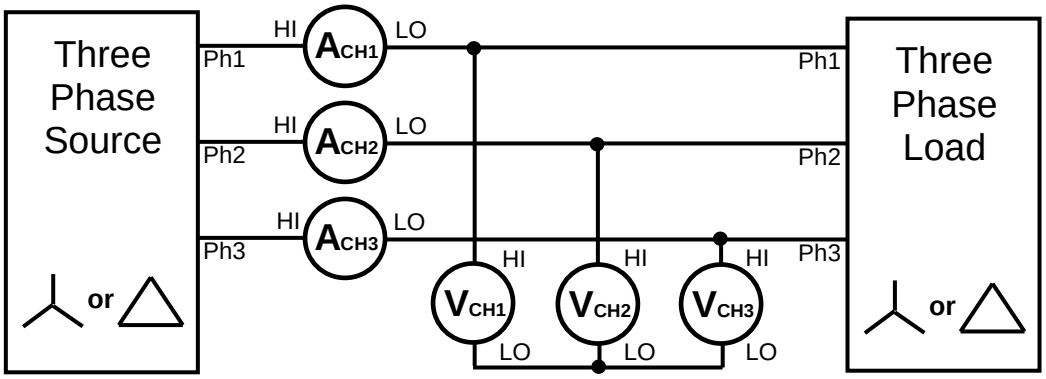
Two Phase Two Wattmeter



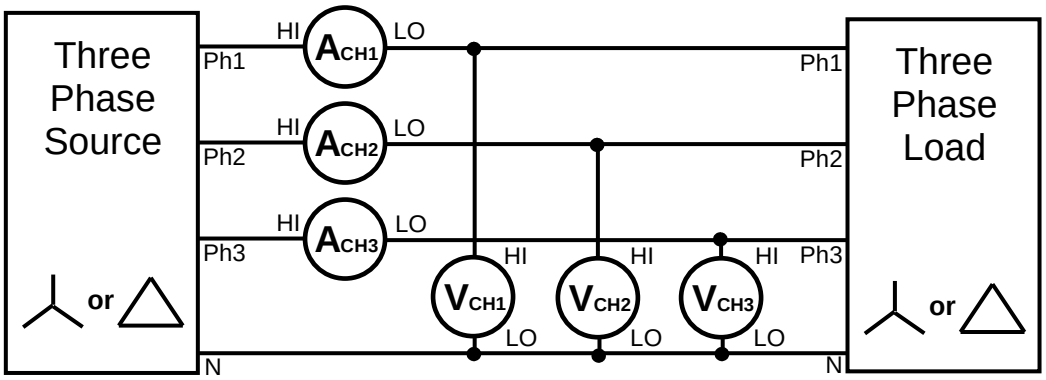
Three Phase Two Wattmeter



Three Phase Three Wattmeter - simulated neutral



Three Phase Three Wattmeter



On a multi phase instrument all the phases usually use the same input control data – internal/external, scaling factor etc. It is possible to select 'independent' so that the phases can be set up differently. This is useful if different scaling factors are required for external shunts or if one phase is using internal shunt when others are external.

7.2 ACQU - Acquisition options

In normal acquisition mode the window over which the measurements are computed is adjusted to give an integral number of cycles of the input waveform. The results from each window are passed through a digital filter equivalent to a first order RC low pass filter.

There are five pre-set speed options – very fast, fast, medium, slow, and very slow – that adjust the nominal size of the window, and therefore the update rate and the time constant of the filter. Greater stability is obtained at the slower speed at the expense of a slower update rate.

There is also an option to set a specific size of the window to a value other than the preset options. In order to synchronise to an integral number of cycles, the window size is either reduced by up to 25% or increased as necessary.

Note that at low frequencies, the window is extended to cover a complete cycle of the input waveform even if this is a longer period than the nominal update rate.

There are two time constants for the smoothing filter, normal or slow, or the filter can be deselected. The nominal values are:

speed	update rate	normal time constant	slow time constant
Very Fast	1/80s	0.05s	0.2s
fast	1/20s	0.2s	0.8s
medium	1/3s	1.5s	6s
slow	2.5s	12s	48s
very slow	10s	48s	192s

The smoothing response is usually set to ‘auto reset’ where the filtering is reset in response to a significant change in data. This speeds up the response of the instrument to changing conditions. This function can be disabled so that the filtering has a fixed time constant, which would have an exponential response to a step change.

The frequency may be measured from the voltage or current. On a multi-phase instrument, any channel may be selected for the frequency measurement.

Phase angle measurements have to be made with reference to a specific input – normally phase 1 voltage. The phase angle reference can be set to current which is useful if operating the instrument with only current inputs, or with low level voltage inputs. In multi-wattmeter wiring modes, phase 1 is always used for the phase angle reference; phase 2 or phase 3 is used when in single phase 2 wiring or single phase 3 wiring.

A frequency filter, 4kHz low-pass, may be selected to filter out the hf carrier component of a PWM waveform ensuring measurements are carried out on the fundamental frequency.

Normal frequency measurement is from 5Hz upwards so that there is not a very long delay if measuring dc. There is a low frequency option that extends the frequency measurement down to 20mHz. This low frequency option also applies a digital filter, which can be useful when measuring in a low frequency, noisy environment.

7.2.1 Advanced options

Pressing ACQU to access the acquisition control menu then the R arrow key gives access to some advanced options

which would not be needed for normal measurement applications.

The analysis for the fundamental component uses a DFT (discrete Fourier transform) algorithm. The selectivity of the DFT analysis is a compromise between noise rejection of frequencies close to the frequency of the fundamental component and the required stability of the frequency component. Selecting “narrow” increases the selectivity of the DFT analysis (reducing the effective bandwidth) which has the effect of improving the noise rejection. It does however require that the frequency of the fundamental component is more stable.

In a noisy application any spikes present on the signal may push the instrument onto a higher range than is necessary for the signal being measured. If the nature of the spurious spikes are such that they do not contribute to the measurement and can safely be ignored then the range can be manually set as appropriate for the signal to be measured and the instrument can be told to ignore any overload. If using this mode it is wise to check the signal on the oscilloscope to be sure that the signal being measured is not genuinely overrange.

In a very noisy application, where the frequency of the signal is known but KinetiQ is unable to measure the frequency even with low frequency mode filters applied, it is possible to enter the frequency to be used for analysis. When ‘frequency lock’ is selected to be ‘on’ the present measured frequency is displayed but this can be overwritten with the known frequency. This entered frequency is then used for all the analysis and the frequency of the input signal is not measured.

7.3 COUPLING - coupling options

There are three coupling options - AC only, AC+DC, or DC only. AC+DC coupling is the normal option and should be used where possible. AC coupling should be used for measuring signals that are biased on a dc level (such as an amplifier operating on a single supply or the output of a dc PSU). DC coupling should be selected when making DC measurements as it prevents noise from resetting the frequency measurement algorithm.

In multi-phase applications, if independent CH3 input control has been set (in the acquisition menu for the PPA1530) then the coupling options are independently set for PH1 + PH2 together and PH3 separately.

Coupling option	Measurement bandwidth	Notes
ac+dc	dc – 1MHz	default
ac	5Hz – 1MHz	
dc	dc – 1MHz	* dc coupling disables auto frequency search and no compensation is applied.

Measurement bandwidth is limited to c.100kHz in internal – x10 mode regardless of the coupling setting.

7.4 RANGE - input channel options

All the input channels are fully isolated from each other and from earth with very high CMRR (common mode rejection ratio). They are controlled independently but sampled synchronously.

Each input channel has an external input as well as an internal shunt or high voltage attenuator. The external input gives versatility in the input ranging by using external shunts or attenuators. If the external shunt or external attenuator option is selected, the data is scaled by the appropriate value (entered under the relevant channel menu).

The PPA1500/500 also features an 'internal – x10' input mode, which applies a gain of 10 to the internal attenuator/shunt signals, at the expense of bandwidth. This input mode has a bandwidth of approximately 100kHz. Selection of this feature is indicated in blue in the RANGE menu and in the Operating Mode displays.

Precision low inductance current shunts or current transformers may be used with the current channels; high voltage attenuators or oscilloscope probe may be used with the voltage channels. **Note that when using external shunts or attenuators on high voltage signals, the inputs must not exceed 1000V rms cat II, or 600V cat III, to ground.**

There are 8 input ranges with nominal full scale values set with a ratio of 1:√10. This gives the following nominal peak ranges:

Range	internal current	internal voltage	external input
1	100mA	1V	1mV
2	316mA	3.16V	3.16mV
3	1A	10V	10mV
4	3.16A	31.6V	31.6mV
5	10A	100V	100mV
6	31.6A	316V	316mV
7	100A	1kV	1V
8	316A	3.16kV	3.16V

The actual ranges have approximately 20% overload headroom so, for example, the 300V range which has a nominal full scale of 316V pk, has an actual peak input value of 380V allowing for the 20% headroom.

The ranges may be selected manually, or by autoranging (default). To speed up the autoranging, the start range for autoranging may be selected if it is known that the signal will not be below a certain level.

There is also an option to autorange ‘up only’ so that a test may be carried out to find the highest range. Once the highest range has been determined, the range can be set to manual and the test carried out without losing any data due to range changing. Pressing the TRIGGER key (or sending *TRG) restarts the autoranging from the selected minimum range.

In multi-phase applications it is usual to allow the phases to independently range but there is an option to lock the ranges across the phases. When enabled, this means that all the voltage channels will be on the same range, and all the current channels will be on the same range.

When in an input channel menu, the ZERO key provides a quick way to lock and unlock the range. When no flashing box is visible in the input channel menu and autoranging is selected, pressing the ZERO key selects the range that the instrument is currently using and sets the autoranging to manual, thus locking the range and preventing further autoranging. Pressing the ZERO key again returns to full autoranging from the bottom range.

For most measurement functions full autoranging is the most suitable option but some applications, such as where transient events are occurring, are more reliable with manual ranging. Manual ranging (or up-only autoranging) is essential for low frequency measurements.

Separately from the current shunt and attenuator value, a scaling factor can be entered for each channel.

In multi-phase applications, if independent ranging has been set (see system options) then the ranging options may be independently set on each phase. Press the R and L keys to step between the phases.

7.5 DATALOG – datalog options

KinetiQ can store and display measurements recorded at regular intervals over a time period. Each data record consists of the elapsed time and up to four data values selected by ZOOM. The instrument can graph and display all four sets of measurements simultaneously.

The actual interval between data points is governed by the measurement speed and the datalog interval. KinetiQ stores the next available measurement after the datalog interval has elapsed: the actual elapsed time is attached to each datalog record, displayed with the data on the table or each graph, and returned with each record over the communications (RS232, USB or LAN).

The data values may be stored to an external memory device (memory stick) as each value becomes available. In this mode the data may be viewed in real time, as it is being acquired.

For high speed data acquisition, the datalog interval may be set to zero so that each measurement is stored. The measurement interval is controlled with the ‘speed’ option in the ACQU menu. Using the ‘window’ option for speed allows greater control of the measurement interval. In this mode, the display flashes ‘DATALOG RUNNING’ and only shows the acquisition time. The minimum datalog interval depends on the function but is typically 10ms.

Note that in all cases the measurement interval is necessarily adjusted to be an integral number of cycles of the measured waveform.

Press DATALOG to set up the datalog options. The datalog is started with the START key, and stopped with the STOP key unless the store becomes full first. The zero reference

for the elapsed time is taken as the first data measurement after START.

The data can be viewed as a table or as individual graphs. Pressing GRAPH steps the graph through the stored parameters. If more than 250 records have been stored, the graph can show the data for the whole period or pressing ZOOM redraws the graph to show 250 records about the cursor. The cursor can be moved in single steps (L or R) or large steps (UP or DOWN). Movements of the cursor are synchronised in both the TABLE and GRAPH views.

7.6 MATHS – custom result computation

Non-standard results may be computed from a combination of voltage and current parameters, signals on the torque and speed inputs, and constants.

There are 3 formulae, each combining up to 4 terms:

1: (term1 + term2) / (term3+term4)
2: (term1 + term2) x term3 / term4
3: term1 x term2 / (term3+term4)

Each term comprises a result, scaled by a signed factor, or a signed constant.

For example, consider the formula:

maths = Vpk.Apk / √2

Select formula 2 with:

term1 = voltage peak x 1.0
term2 = disabled
term3 = current peak x 1.0
term4 = constant x 1.414

or

term1 = voltage peak x 1.0
term2 = disabled
term3 = current peak x 0.7071
term4 = disabled

The selected formula is applied to the data from each phase.

The result is displayed with a user definable label of up to 12 characters and units up to 8 characters.

7.7 AUX – Auxiliary Devices

PCIS Inrush Switch – (Phase Controlled Inrush Switch)

Accessory for the PPA range to provide the precise measurement of Inrush Current on a single phase AC load.

Application: When measuring the maximum inrush current taken by a load, it is necessary to switch on the supply at a specific point in the voltage cycle. The point at which maximum inrush current will be drawn is dependent upon the type of load being tested, but usually this is 90º or 270º for capacitive loads and 0º or 180º for an inductive load. It can also be useful to measure the inrush current at intermediate points between the maximum and minimum levels; therefore an ideal phase switching device allows the selection of phase angle at increments of 45º

8 Application specific modes

Select the application specific options form the APP menu.

8.1 Lighting ballast

Electronic lighting ballast waveforms consist of a high frequency carrier signal modulated by the line frequency. KinetiQ measures the line frequency independently of the input waveform frequency and synchronises the measurement period to the line frequency.

The carrier frequency measurement ignores any ‘dead band’ around the zero crossing of the ac line to compute the actual switching frequency of the ballast.

Both the frequency measured on the input waveform and the frequency of the line input are displayed.

As the switching frequency can vary over the cycle, the analysis frequency of the DFT measurement is continually adjusted to give optimum measurement of the fundamental and harmonics. The response of the tracking algorithm can be adjusted to suit the ballast being measured:

Fixed time (no adjustment)
Fast
Medium
Slow

To select lighting ballast mode, press the APP key, select the mode with the cursor keys, move down to the ‘default settings’ option and press ENTER. The defaults are loaded and the particularly important parameters can then be changed.

8.2 Inrush current

Measurement of inrush current (surge) requires very fast sampling to catch the highest instantaneous value. Measurements must be made under conditions of manual ranging and with the voltage applied to the instrument. Then when the load is switched on the highest peak value can be detected. In inrush mode, KinetiQ samples and analyses every sample at the full sample rate of 1Msamples/s to catch even very fast peaks.

For the worst case inrush current the input to the device under test must be switched on at the worst point in the cycle (90° or 270° for a capacitive load, 0° or 180° for an inductive load). The Phase Controlled Inrush Switch, or PCIS, available as an accessory for KinetiQ, controls the switch on of the power to the DUT from 0° to 315° in steps of 45° from the KinetiQ front panel.

ENTERing the default settings in inrush mode in the application menu selects the PCIS and sets KinetiQ to manual ranging. If PCIS is not being used then it can be deselected in the AUX menu. Having selected the default settings, the current range should be set to an appropriate range for the DUT.

The oscilloscope mode (PPA15xx only) is also useful for qualitatively evaluating the inrush current.

8.3 Standby power measurement

In order to minimise standby power, some devices operate in a ‘dormant’ mode whereby power is only drawn from the supply when needed. These devices draw very little current for most of the time and then draw a larger current for a single cycle to charge a reservoir capacitor. This pattern is repeated on an irregular basis.

Most of the power consumed by devices in this mode is taken in the periodic higher current cycles so to accurately measure the power drawn by these devices, so the instrument synchronises to the power frequency for the analysis but extends the measurement window to the irregular period of higher energy pulses. Because the instrument samples in true real time without any gaps, no data is missed and every power cycle is captured.

It is important that ranging is set to manual or up only autoranging so that the power cycles are not missed while ranging.

9 Power measurements

In the POWER mode, KinetiQ measures the following values for each phase:

Parameter	Type	Units
Frequency	elementary	Hz
True power	elementary	W
Apparent power	secondary	VA
Reactive power	secondary	VAr
Power factor	secondary	
RMS voltage	elementary	V
RMS current	elementary	A
Fundamental power	secondary	W
Fundamental VA	secondary	VA
Fundamental VAr	secondary	VAr
Fundamental power factor	secondary	
Voltage fundamental	elementary	V
Current fundamental	elementary	A
Voltage magnitude	secondary	V
Current magnitude	secondary	A
phase	secondary	degrees
Voltage harmonic	elementary	V
Current harmonic	elementary	A
Voltage harmonic magnitude	secondary	V
Current harmonic magnitude	secondary	A
DC voltage	elementary	V
DC current	elementary	A
dc power	secondary	W
Peak voltage	elementary	V
Peak current	elementary	A
Rectified mean voltage	elementary	V
Rectified mean current	elementary	A

All elementary parameters (e.g. Watts) are computed from their true definitions in real time so the measurements are

valid for all waveshapes. Secondary parameters are computed from one or more of the elementary parameters (eg. VA = Vrms x Arms).

Not all of the parameters listed are displayed in POWER mode but they are all computed.

A multi phase instrument also computes the equivalent values for total power (SUM channel) and the values for the NEUTRAL current. Step through the phase values with NEXT and BACK.

The measurements are computed over rectangular windows with no gaps. The processing power of the DSPs allows the measurements to be made in true real time without missing any samples. In this way, the measured power is a true value even if the signal is fluctuating. The only occasion when data is missed is when an autozero measurement is requested – this can be disabled in the SYTEM OPTIONS menu.

The elementary values are individually filtered before being used for secondary computations.

9.1 Individual phase computations

The power dissipated in a load subjected to a periodic voltage, v(ϕ), with a current flowing a(ϕ), is given by:

$$w = 1/2\pi \int_0^{2\pi} v(\phi).a(\phi)\, d\phi$$

For a sampled signal, the formula becomes:

$$w = 1/n \sum_{i=0}^{i=n-1} v[i].a[i]$$

Where n is the number of samples for an integral number of complete cycles of the input waveform.

The rms value of a periodic waveform, v(ϕ), is given by:

$$rms = \sqrt{\left[\ 1/2\pi \int_0^{2\pi} v^2(\phi)\, d\phi\ \right]}$$

For a sampled signal, the formula becomes:

$$rms = \sqrt{\left[\ 1/n \sum_{i=0}^{i=n-1} v^2[i]\ \right]}$$

Where n is the number of samples for an integral number of complete cycles of the input waveform.

The dc present is given by:

$$dc = 1/2\pi \int_{0}^{2\pi} v(\phi)\, d\phi$$

For a sampled signal, the formula becomes:

$$dc = 1/n \sum_{i=0}^{i=n-1} v[i]$$

Where n is the number of samples for an integral number of complete cycles of the input waveform.

From these elementary values of W, rms and dc, the following secondary values can be derived:

VA		$= V_{rms} \times A_{rms}$
VAr		$= \sqrt{(VA^2 - W^2)}$
power factor	= W/VA	
W_{dc}		$= V_{dc} \times A_{dc}$

The fundamental in-phase and quadrature values of a periodic waveform, $v(\phi)$, are given by:

$$a_1 = 1/\pi \int_0^{2\pi} v(\phi).\cos(\phi)\, d\phi$$

$$b_1 = 1/\pi \int_0^{2\pi} v(\phi).\sin(\phi)\, d\phi$$

For a sampled signal, the formulae become:

$$a_1 = 1/n \sum_{i=0}^{i=n-1} v[i].\cos(2\pi ci/n)$$

$$b_1 = 1/n \sum_{i=0}^{i=n-1} v[i].\sin(2\pi ci/n)$$

Where n is the number of samples for an integral number of complete cycles of the input waveform, and c is the number of cycles.

These ‘a’ and ‘b’ values yield the further elementary parameters:

$$\text{magnitude} = \sqrt{(a^2 + b^2)}$$

$$\text{phase angle} = \tan^{-1}(b/a)$$

From these elementary ‘a’ and ‘b’ values of voltage and current, the following secondary values can be derived:

fundamental Watts $= V_a \times A_a + V_b \times A_b$
fundamental VA $= V_{mag} \times A_{mag}$
fund power factor $= W_{fund} / VA_{fund}$
fundamental VAr $= V_a \times A_b - V_b \times A_a$

The signs of Watts and VAr are a direct result of the computation (watts has the sign of cos(phase angle), VAr has the sign of sin(phase angle)). The sign of fundamental power factor is determined by convention such that a lagging current (inductive load) is shown as a positive power factor and a leading current (capacitive load) is shown as a negative power factor; this is effectively the sign of sin(-phase angle). Optionally the signs of fundamental VAr and power factor can be independently inverted.

9.2 Sum computations

When in 3 phase wiring modes (2 Wattmeter or 3 Wattmeter), the values for the total load are computed from the data for each individual channel.

W, VA, VAr, W.f, VA.f , VAr.f, W.dc, and W.h are computed as the sum of the individual phase data.

V.rms, V.mag, V.pprms and V.ppmag are computed as the average of the individual phase data.

A.rms and A.mag are computed from sum VA / sum V and sum VA.f / sum V.f respectively then may optionally be divided by the number of phases to give the average.

Sum power factor is computed as sum W / sum VA and the fundamental power factor is computed as fundamental sum W / fundamental sum VA with the sign derived from the sign of sum VAr.

When calculating 3 phase 2 wattmeter Sum:VA and VAr, options are as follows:

For low distortion signals:

$$sum.VAr = ph1.VAr + ph2.VAr$$

$$sum.VA = \sqrt{(sum.W^2 + sum.VAr^2)}$$

For High distortion signals:

$$sum.VA = \frac{\sqrt{3}}{2}(ph1.VA + ph2.VA)$$

$$sum.VAr = \sqrt{(sum.VA^2 - sum.W^2)}$$

9.3 Neutral synthesis

In 3 phase 3 wattmeter configuration, the values for the neutral current are synthesised from the calibrated values of the three phases. By Kirchoff's law the sum of the instantaneous currents flowing into a node must be zero. By convention neutral current is regarded as flowing out of the load so the neutral current can be derived from the sum of the three phase currents.

In 3 phase 2 wattmeter configuration, the "neutral current" values are synthesised from the 2 phase currents and represent the third phase current.

Values available are rms, fundamental magnitude and phase. Additional values for dc, ac, peak and crest factor are displayed in RMS mode.

9.4 Phase to phase computations

In 3 phase 3 wattmeter configuration, the voltmeters are connected across each individual phase and neutral. The phase to phase voltages are synthesised from the individual phase data:

display phase	computation
phase 1	phase 1 – phase 2
phase 2	phase 2 – phase 3
phase 3	phase 3 – phase 1

Phase to phase values are computed for rms, fundamental magnitude and phase.

Consider the fundamental component:

$$V_{12}(t) = V_1(t) - V_2(t)$$
$$= V_1 \sin(\omega t) - V_2 \sin(\omega t + \varphi_{12})$$
$$= V_1 \sin(\omega t) - V_2 [\sin(\omega t).\cos(\varphi_{12}) + \cos(\omega t).\sin(\varphi_{12})]$$
$$= \sin(\omega t) [V_1 - V_2 \cos(\varphi_{12})] - V_2 \cos(\omega t).\sin(\varphi_{12})$$

In a balanced system:

$$V_1 = V,\ V_2 = V \text{ and } \varphi_{12} = 120^\circ$$

$$V_{12} = \sin(\omega t) [V - V \cos(120^\circ)] + V \cos(\omega t).\sin(120^\circ)$$
$$= 1.5\ V \sin(\omega t) - \sqrt{3}/2\ V \cos(\omega t)$$
$$= \sqrt{3}\ V \sin(\omega t - 30^\circ)$$

So the phase to phase voltage would have a magnitude $\sqrt{3}$ times larger than the phase to neutral voltage at a phase displacement of -30°.

KinetiQ applies the computations in the general way without any assumptions about the system. It therefore computes the correct values whatever the waveform.

The phase to phase values may also be displayed as a rectified mean measurement.

9.5 Efficiency

Efficiency may be computed as a ratio of:

phase 1 and phase 2 power

phase 3 and sum power

In both cases, either term may be input power or output power.

Total efficiency is computed from the total power, fundamental efficiency is computed from the fundamental power.

9.6 Torque & Speed

Torque & Speed can be set for power measurement mode by independently using Phase 3 within the
3 Phase 2 Wattmeter + Phase 3 wiring configuration

Channel 3 Voltage Input BNC = Torque
Channel 3 Current Input BNC = Speed

If using Multilog software:
PH3 Watts = Power
PH3 voltage dc = Torque
PH3 current dc = Speed

10 Integrated power measurements

In the INTEG mode, KinetiQ computes the following additional values:

Parameter	Units
Watt hours	Wh
VA hours	VAh
VAr hours	VArh
Average power factor	
Average rms voltage	V
Ampere hours	Ah
Fundamental watt hours	Wh
Fundamental VA hours	VAh
Fundamental VAr hours	VArh
Average fundamental power factor	
Average fundamental voltage	V
Fundamental ampere hours	Ah

The integrator is started by pressing the START key; the elapsed time is displayed in the upper left corner of the display. The integration can be stopped by pressing the STOP key then restarted by pressing the START key again. To reset the accumulated values and time press the ZERO key. While the integration is running, pressing the REAL TIME key holds the displayed values but accumulation continues in the background.

Once started, the integration continues to accumulate in the background even if the MODE is changed to POWER or RMS. This allows the real time values to be displayed without disturbing the integration.

To make an integrated measurement over a specific interval, an integration run time can be entered in hours and minutes. The integration will automatically stop when the integration timer reaches the value entered, as if the

STOP button had been pressed. Setting the integration time to zero, disables the timer.

The Watt hour integration and the Ampere hour integration can be selected to be signed or magnitude. To integrate the total power in terms of heating effect, choose magnitude. If signed integration is selected then the rms current is given the sign of the power before integration. The Ampere hours and Watt hours then reflect the power taken by the load, less any power generated by the load, such as during regenerative braking in battery systems.

The integrated results may be displayed as the total accumulated values or as the average over the integration period.

11 True RMS Voltmeter

The RMS voltmeter displays the additional secondary parameters of ac, crest factor, surge, mean and form factor:

Having computed the true rms and the dc component, the ac component can be derived from:

$$rms^2 = ac^2 + dc^2 \qquad => \qquad ac^2 = rms^2 - dc^2$$

Crest factor is derived from the peak and rms:

$$cf = peak / rms$$

In order to measure surge conditions, the maximum instantaneous peak value (unfiltered) is also recorded. It is important that KinetiQ does not autorange while measuring surge – either set the range to manual or repeat the test several times with ranging set to up only. To reset the maximum, press TRIGGER.

The mean value, also known as rectified mean, is computed by the arithmetic mean of the absolute value of the samples:

$$mean = 1/2\pi \int_0^{2\pi} |v(\phi)|\, d\phi$$

For a sampled signal, the formula becomes:

$$mean = 1/n \sum_{i=0}^{i=n-1} |v[i]|$$

where n is the number of samples for an integral number of complete cycles of the input waveform.

Note that the mean value will not give the same measurement as rms. The form factor indicates the ratio of mean to rms:

form factor = rms / mean

For an undistorted sinewave, the form factor is given by:

sine wave form factor = $\pi / 2\sqrt{2}$ = 1.11072

There is also an option to normalise the rectified mean measurement (factor = pi / 2root2 = 1.11072) as form factor is always computed from the absolute value (before normalisation).

Both Voltage and Current positive and negative peak are available, filtered and unfiltered.

12 Harmonic analyser

The HARM mode of KinetiQ computes multiple DFTs on the input waveforms in real time.

There are two modes of operation: difference THD, and series harmonics. Series harmonic mode includes options for THD, TIF, THF, TRD, TDD and phase. There is also an option of a series harmonic bargraph display (PPA15xx only) which shows both the voltage and current harmonics simultaneously.

In difference THD mode, the THD (Total Harmonic Distortion) is computed from the rms and fundamental:

$$THD = 1/h_1 \sqrt{(rms^2 - h_1^2)}$$

In series THD mode, the THD is computed from a series of up to 50 harmonics.

$$THD = 1/h_1 \sqrt{\sum_{i=2}^{i=n} h_i^2}$$ where h_i is the i^{th} harmonic

TIF (Telephone Influence Factor) is similar to THD but each harmonic has a weighting factor applied to reflect the severity of the potential interference of that harmonic on telephone communication.

$$TIF = 1/rms \sqrt{\sum_{i=1}^{i=n} (h_i \times t_i)^2}$$

where h_i is the i^{th} harmonic
and t_i is the i^{th} weighting factor

TIF is defined by IEEE standard 115 and the weighting factors are given in ANSI standard C50-13. The harmonic factors for TIF are specified for harmonics of 60Hz.

THF (Telephone Harmonic Factor) is a similar computation to TIF but uses different weighting factors and is expressed as a percentage.

$$THF = 1/rms \sqrt{\sum_{i=1}^{i=n} (h_i \times t_i)^2}$$

where h_i is the i^{th} harmonic
and t_i is the i^{th} weighting factor

The THF computation and weighting factors have been implemented according to IEC standard 60034 part 1 (1996) with amendments A1 (1997) and A2 (1999). The harmonic factors are specified for harmonics of 50Hz.

TRD (Total Rated Distortion) uses a different reference to scale the harmonic percentages instead of the fundamental. The voltage harmonics are scaled by the rms voltage, and the current harmonics are scale by the larger of the rms current or the rated current entered by the HARM menu. The rms is computed from the series of harmonics.

$$TRD = 1/ref \sqrt{\sum_{i=2}^{i=n} h_i^2}$$

where h_i is the i^{th} harmonic
and ref is rms or rated current

Similarly, TDD (Total Demand Distortion) scales the computed harmonic distortion by the measured rms. For voltage, TDD is the same as TRD; for current, TRD is less

than TDD unless the measured rms current is greater than the entered rated current.

The value for TRD and TDD will always be lower than the computed THD as rms is always greater than the fundamental.

$$TDD = 1/rms \sqrt{\sum_{i=2}^{i=n} h_i^2}$$

where h_i is the i^{th} harmonic

Harmonic phase can be selected instead of a thd computation and each harmonic in the series is computed as a magnitude and phase angle.

The number of harmonics used for THF, TIF, TRD, TDD and series harmonic phase computation is selectable in the same way as for THD.

In all cases the harmonics are phase referred to Phase 1 voltage fundamental so that their in-phase and quadrature components may be separately filtered to minimise noise.

Accurate frequency synchronisation is essential for reliable harmonic measurement. Good results can be obtained in a reasonable time using the medium speed setting (which runs a little slower than other modes) but for the best results, use the slow speed setting.

13 Impedance meter

The IMP mode on KinetiQ uses the real and imaginary components at the fundamental frequency using DFT analysis as described previously to compute the impedance of the load and associated parameters.

From the fundamental components of voltage, (a + jb), and those of the current, (c + jd), KinetiQ computes the complex impedance given by:

$$\mathbf{z} = \mathbf{v} / \mathbf{i}$$
$$= (a + jb) / (c + jd)$$

The components of the complex impedance are filtered independently to minimise the effects of noise, which would have random phase and would therefore be filtered out.

The magnitude of the voltage and current are also computed.

From the complex impedance the following parameters can be derived:

resistance
inductance,
capacitance
impedance
phase
tanδ (= real/imaginary)
Q factor (= imaginary/real)

Values can displayed for either series or parallel models.

If the parameter option in LCR menu is set to ‘auto’, KinetiQ will display capacitance or inductance according to

the phase of the measurement. Alternatively, the display can be forced to capacitance, inductance or impedance.

Capacitance is displayed with tanδ, inductance is displayed with Q factor, and impedance is displayed in its resistive + reactive form and as magnitude. The phase of the impedance is displayed with all options.

For phase critical impedance measurements, is it possible to offset the phase measurement to allow for phase shift within the connection leads.

Note that the phase of the impedance is the opposite to the phase of the current in POWER mode. This is because the impedance is defined as voltage/current which, considering the magnitude and phase of Z (impedance), V (voltage) and A (current), gives:

Zmagnitude = Vmagnitude / Amagnitude
Zphase = Vphase – Aphase

As the phase is referred to the voltage:

Zphase = - Aphase

Therefore, using the phase convention from -180° to +180°, an inductive load which has an impedance with positive phase would cause a current with negative phase.

14 Oscilloscope mode (PPA15xx only)

KinetiQ provides a storage oscilloscope function in order to view the waveforms being measured.

The display for the oscilloscope is divided into 10 divisions along the time axis with the selected timebase displayed in units of time/division. The timebase may be set to any real value between 15μs/div to 5s/div using the SCOPE menu. Pressing L and R adjust the timebase by a factor of 2. For slow timebase operation, (> 0.8s/div) the display operates in ‘roll’ mode where the waveform scrolls across from left to right until triggered.

Two cursors can be enabled on the display. If cursors are “on” in the menu (press SCOPE or MODE) then the L and R key mode the selected cursor, UP and DOWN toggle which cursor is selected. The time difference between the 2 cursors, ‘delta t’, is displayed on the lower left of the display. When the cursors are enabled, L and R no longer adjust the timebase.

The vertical scaling is shown as a full scale value, rather than as a V/cm. This indicates the range that the instrument is using for each channel.

Triggering is very important to obtain a stable trace and there are various options to control the trigger:

source
level
type
polarity
HF reject
pretrigger

The data source for the trigger can be selected to be either voltage or current. On a mutiphase instrument, any of the phases may be selected for the trigger source.

The trigger level is set directly in Volts or Amps and does not change if the range is changed, i.e. it is an absolute trigger level and not relative to the range full scale. Pressing NEXT and ENTER adjust the trigger level by a factor of 2.

The trigger level is shown as a small horizontal bar on the extreme left-hand edge of the display against the appropriate channel. If the trigger is set to a value above or below the range of the input channel then a small carat ^ is shown at the top or inverted at the bottom of the display as appropriate.

The trigger type may be set to:

auto	(trigger if possible but do not wait)
normal	(wait indefinitely for trigger)
single shot	(wait for trigger then hold)

The single shot option is reset using the TRIGGER key.
The trigger polarity may be set to rising edge or falling edge.

When ‘trigger HF reject’ is on, a low pass filter is applied to the trigger data to stabilise the trace with noisy signals. The filter only influences the trigger detection and does not change the data displayed.

Pretrigger may be set to:

none
25%
50%
75%

Autoranging can be used with the oscilloscope functions but it is more customary to fix the range manually particularly when looking for a single event in ‘single shot’ mode. Manual ranging is essential for rare events with a low mark space ratio.

15 Phase meter

The phase meter mode is a secondary function which does not have a separate button. It is selected by stepping through the operating mode via the MODE menu.

The phase meter uses the terminology of channel 1 for voltage and channel 2 for current as it is normal to use a phase meter to compare voltages directly. In this case the current input is set to external attenuator in the RANGE menu, and a voltage probe (oscilloscope probe) can be used. For optimum phase accuracy the same type of voltage probe should be used for the voltage input which can also be set to external attenuator in the RANGE menu. Remember to trim the oscilloscope probes if necessary by connecting them to a 1kHz square wave and adjusting them for 33.3% 3rd harmonic in the harmonic analyser mode.

The phase meter measures the phase and gain of channel 2 relative to channel 1 using a discrete Fourier transform (DFT) algorithm at the fundamental frequency. Relative gain is given as an absolute value and in dB. The ratio can be inverted to give the gain of channel 1 relative to channel 2.

To look at differences in gain from a nominal value, an offset gain can be applied either manually or by pressing ZERO.

$$\text{offset gain} = \text{measured dB} - \text{offset dB}$$

16 Specifications & Comparisons

Frequency Range

Normal: DC and 10mHz to 1MHz
x10 mode: DC and 10mHz to 100kHz

Voltage Input

Ranges: Normal - 1Vpk to 2500Vpk (1000Vrms) in 8 ranges
x10 mode - 100mVpk to 300Vpk in 8 ranges
Accuracy: Normal - 0.05%Rdg +0.1%Rng +(0.005% x kHz) +5mV*
x10 mode - 0.05%Rdg +0.1%Rng +(0.01% x kHz) +1mV*
External sensor input: 1mVpk to 3Vpk in 8 ranges – BNC connector
Accuracy 0.05%Rdg +0.1%Rng +(0.005% x kHz) +1µV*

Current Input

20Arms

Accuracy: Normal - 0.05%Rdg +0.1%Rng +(0.005% x kHz) +500uA*
x10 mode - 0.05%Rdg +0.1%Rng +(0.01% x kHz) +100uA*

30Arms

Accuracy: Normal - 0.05%Rdg +0.1%Rng +(0.005% x kHz) +1A*
x10 mode - 0.05%Rdg +0.1%Rng +(0.01% x kHz) +300uA*

External sensor input: 1mVpk to 3Vpk in 8 ranges – BNC connector
Accuracy 0.05%Rdg +0.1%Rng +(0.005% x kHz) +1µV *

Phase Accuracy

Normal: 10 millidegrees + (10 millidegrees x kHz)
x10 mode: 10 millidegrees + (20 millidegrees x kHz)

Watts Accuracy

Normal: [0.1% +0.1%/pf +(0.015% x kHz)/pf] Rdg +0.1%VA Rng
x10 mode: [0.1% +0.1%/pf +(0.02% x kHz)/pf] Rdg +0.1%VA Rng

40Hz-850Hz Accuracy – V,A and Watts

As above with range error reduced from +0.1%V,A,VA Rng to +0.05%V,A,VA Rng

DC Accuracy

Voltage:
0.1% Rdg + 0.1% Rng + 10mV (or +2mV in X10 mode)
Current:
(20Arms) 0.1% Rdg + 0.1% Rng + 1mA (or +200µA in X10 mode)
(30Arms) 0.1% Rdg + 0.1% Rng + 3mA (or +600µA in X10 mode)
External sensor input: 0.1% Rdg + 0.1% Rng + 10µV

Total Harmonic Distortion (THD) Accuracy

$$THD + THD\ Error = \left(\frac{1}{h1 + h1\ error}\right)\sqrt{\sum_{i=2}^{i=n}(hi + hi\ error)^2}$$

Voltage:

hi error (Voltage) = 0.05% hi rdg + 0.1% rng + 0.005% * KHz + 5mV
x10 mode:
hi error (Voltage) = 0.05% hi rdg + 0.1% rng + 0.01% * KHz + 1mV

Current:

20A:
hi error (Current) = 0.05% hi rdg + 0.1% rng + 0.005% * KHz + 500uA
X10 mode:
hi error (Current) = 0.05% hi rdg + 0.1% rng + 0.01% * KHz + 100uA

30A:
hi error (Current) = 0.05% hi rdg + 0.1% rng + 0.005% * KHz + 1A
X10 mode:
hi error (Current) = 0.05% hi rdg + 0.1% rng + 0.01% * KHz + 300uA

External Sensor Input:

hi error (Voltage) = 0.05% hi rdg + 0.1% rng + 0.005% * KHz + 1uV

Common Mode Rejection

Total Common Mode and Noise effect on current channels
Applied 250V @ 50Hz – typical 1mA (150dB)
Applied 100V @ 100kHz – typical 3mA (130dB)

Datalog

Functions	Up to 4 measured functions user selectable (30 with optional PC software)
Datalog window	From 10ms with no gap between each log
Memory	RAM up to 16,000 records

General

Crest factor	Voltage and Current – 20
Sample rate	Real time no gap - 1Ms/s on all channels
Low power accuracy	Compliant with IEC62301 using internal shunt Refer to low power measurement application note
Remote operation	Full capability, control and data
Application modes	Ballast Inrush

Ports

RS232	Baud rate to 38400 – RTS/CTS flow control
LAN (option L)	10/100 Base-T Ethernet auto sensing RJ45
USB	USB device – 2.0 and 1.1 compatible
Extension	N4L accessory port
Aux	N4L auxiliary port

Physical

Display	480 x 272 pixel 4.3” colour TFT
Size	91H x 213W x 313D mm – excluding feet
Weight	3.6kg – 1 phase; 4kg – 3 phase
Safety isolation	1000V rms or dc – category II
Power supply	90-265 rms 50-60Hz 35VA max

* measured fundamental value

PPA SERIES COMPARISON TABLE	**PPA1500/500**	**PPA25/2600**	**PPA5500**
Accuracy			
Basic V & A reading + range	**0.05% + 0.1%**	0.04% + 0.04%	0.02% + 0.04%
Power reading + VA range	**0.1% + 0.1%**	0.05% + 0.05%	0.03% + 0.05%
Voltage Input			
Direct Voltage	**2500Vpk**	3000Vpk	3000Vpk
Ranges	**8**	8	9
Direct current input options			
10Arms		10mA-30Apk	3mA-30Apk
20Arms	**10mA - 30Apk ♦ 100mA - 300Apk**		
30Arms		100mA-300Apk	30mA-300Apk
50Arms		300mA-1000Apk	100mA-1000Apk
Ranges	**8**	8	9
Bandwidth			
	DC to 1MHz	DC to 2MHz	DC to 2MHz
	DC to 100kHz ♦	DC to 1MHz (50A)	DC to 1MHz (50A)
Selectable Low BW		✓	✓
General features			
Display	**High contrast Colour Graphic**	BW Graphic	High contrast Colour Graphic
Processing power - Harmonic computations per second	**300**	300	1,800
Non volatile internal Memory	**192kB**	192kB	1GB
USB port for memory drive	✓		✓
Plug in USB memory drive - supplied standard			2GB
Non volatile real time clock	✓		✓
Analogue output			✓
Internal datalog functions	**4**	4	16 (4 x 4)
Datalog record storage capacity	**16,000**	8,000	10,000,000
Frequency measurement accuracy	**0.02%**	0.02%	0.001%
Application modes			
PWM		✓	✓
Lighting	✓	✓	✓
Inrush	✓	✓	✓
Transformer		✓	✓
Standby Power	✓	✓	✓
Mechanical			
Handle	**Adjustable**	Fixed	Adjustable
Tilt	**Multiple position**	Single position	Multiple position
19” Rack mounting option		2600✓	✓

PPA1500/500 X10 range mode = ♦

Appendix A – Accessories

Supplied Standard Accessories

Leads	Power, RS232, USB
Connection cables	20Arms rated 1.5 meter long leads with 4mm – stackable terminals 1x Yellow, 1 x Red and 2x Black per phase
Connection clips	4mm terminated alligator clips – 1x Yellow, 1 x Red and 2x Black per phase
Documentation	Calibration Certificate, User manual with quick start guide, Communications manual

External shunts

A range of high bandwidth external shunts are available to extend the operating range of the current measurements.

The external shunts are built using an N4L proprietary shunt design to give high accuracy from DC to 1MHz. They are designed to comply with the safety standards of BS EN61010-1 to 1000V rms cat II. The sense output is via safety BNC connection to connect to the instrument, the current connections depend on the device.

Part numbers

HF003	470mΩ 3A rms	4mm safety
HF006	100mΩ 6A rms	4mm safety
HF020	10mΩ 20A rms	4mm safety
HF100	1mΩ 100A rms	safety terminals
HF200	500uΩ 200A rms	M10 stud
HF500	200uΩ 500A rms	M16 stud

PCIS - Phase controlled inrush switch

To measure the maximum inrush current of a load it is important to switch on the supply to it at the worst point in the cycle – usually 90° or 270° for a capacitive load, 0° or 180° for an inductive load.

The PCIS is an active device which is controlled by KinetiQ over the extension port. It accurately synchronises to the line input, measures the frequency, and switches on the output at a precise phase angle selectable from the KinetiQ front panel in steps of 45°.

Part numbers

PCIS	Phase Controlled Inrush Switch

Ultra low capacitance high voltage probes

The KinetiQ voltage inputs have a capacitance to ground of around 50pF but even this low value can cause problems with high frequency high voltage waveforms. The ultra low capacitance high voltage probes use a differential input arrangement optimised for minimum capacitance to achieve an input capacitance to ground less than 1pF with an input range up to ±3kV pk and a bandwidth from dc to 2MHz ±1dB.

The probes connect to the external voltage input using the touchproof BNC cable supplied. They are powered either by an ac/ac mains adaptor or a dedicated ±12V dc supply.

Part numbers

ULCP	Ultra Low Capacitance Probe

External input attenuator

The KinetiQ voltage inputs have a +/-3V peak external input for use with probes or attenuators.

A divide by 10 or divide by 20 passive attenuator with a bandwidth of dc-30MHz (+/-1dB) is available to extend the +/-3V peak input to +/-30V and +/-60V respectively.

The low frequency accuracy is +/-0.3% max

The attenuators have a short flying lead to connect to the external BNC of the instrument.

Part numbers

ATT10	divide by 10 attenuator
ATT20	divide by 20 attenuator

CommVIEW PC software

CommVIEW is a self contained software program for a PC, which facilitates communication with KinetiQ over RS232, USB or LAN.

CommVIEW allows strings to be sent and received between a PC and KinetiQ. The strings can be viewed in a window and optionally stored in a file. Data received from KinetiQ may be displayed in normal scientific notation with an identifying label.

Strings to be sent to KinetiQ can be stored in a “script file” and executed automatically. The script file is created with any text editor and includes three types of lines (interpreted by the first character on each line):

lines beginning with " are sent to KinetiQ
lines beginning with # are commands for CommVIEW
any other line is a comment.

The # commands that are recognised:

#beep	*sound the beeper on the PC*
#label,i,string	*apply a label to data value[i]*
#pause,t	*wait for time t*
#reply,t	*wait time t for a reply*

For an example script file, look at example.scr on the CommVIEW release disc.

Other functions in CommVIEW:

save results	*results menu*
set COM port parameters	*configure menu*
firmware upgrade	*instrument menu*
read/store user programs	*instrument menu*

Appendix B – Serial command summary

command format	reply format
*CLS	
*ESE,value	
*ESR?	single integer data value
*IDN?	company,product,serial no,version
*OPC?	0 or 1
*RST	
*SRE,value	single integer data value
*SRE?	
*STB?	single integer data value
*TRG	
*TST?	single integer data value
*WAI	
ABORT	
ALARM,latch,sounder	
ALARM?	single integer data value
ALARM1,type,data,hi,lo	
ALARM2,type,data,hi,lo	
ALARME,value	
ALARME?	single integer data value
APPLIC,type,setting	
BEEP	
BLANKI,on/off	
CALSNO?	alpha-numeric string
CALSTR,string	
CALSTR?	string
CONFIG,parameter,data	
CONFIG,parameter?	single integer or real data value
COUPLI,phase,coupling	
COUPLI?	numerical value
DATALO,func,interval,speed	
DATALO,LINES?	single integer data value
DATALO,0?	index,time,data... one record per line
DATALO,start,records?	index,time,data... one record per line
DAV?	single integer data value
DAVER,value	
DAVER?	single integer data value
DISPLAY,page	
DISPLAY?	multiple real data values
EFFICI?	total efficiency, fundamental efficiency

FAST on/off	
FQLOCK,on/off	
FQREF,phase,channel	
FREQUE,frequency	
HARMON,para,h,max	
HARMON,phase?	freq,mag1,mag2,hmag1,hmag2,h1,h2,
or	thd1,thd2,hphase1,hphase2
HARMON,SERIES?	mag,%, X n harmonics
or	
HARMON,phase,SERIES?	mag,phase, X n harmonics
HOLD,on/off	
INPUT,channel,type	
INTEGR,type,display	
INTEGR,RUNTIM,hours,mins	
INTEGR,phase?	time,Wh,Wh.f, VArh,VArh.f,VAh,VAh.f, pf,pf.f,Vav,Vav.fAh,Ah.f
KEYBOA,value	
LCR,parameter	
LCR,phase?	freq, Vmag, Amag, impedance, phase, R, L, C, tanδ, Qf, reactance
LOWFRE,on/off	
MODE,type	
MULTIL,index,phase,func	
MULTIL?	up to 30 data values
NEWLOC	multiple sets of data
NOOVER,value	
PFCONV,type	
PHASEM,ratio	
PHASEM,phase?	freq,mag1,mag2,dB,phase
PHCONV,convention	
POWER,sum,type	
POWER,PHASE,WATTS?	freq,W,W.f, VA,VA.f,Var,Var.f,pf,pf.f, Wdc,W.h
POWER,PHASE,VOLTAGE?	freq,rms,mag,dc,ϕ,peak,cf,mean,ff, harmonic
POWER,PHASE,CURRENT?	freq,rms,mag,dc,ϕ,peak,cf,mean,ff, harmonic
POWER,PH-PH?	freq,rms1,mag1,ϕ1,rms2,mag2,ϕ2, rms3,mag3,ϕ3
POWER,RMS?	freq,vrms1,vdc1,arms1,adc1,vrms2, vdc2,arms2,adc2,vrms3,vdc3, arms3, adc3

POWER,VECTORS?	freq,mag1,ϕ1,mag2,ϕ2,mag3,ϕ3, mag4,ϕ4,mag5,ϕ5,mag6,ϕ6
POWER,WVA?	freq,w1,vrms1,arms1,w2,vrms2, arms2,w3,vrms3,arms3
PROGRA,function,number	
PROGRA?	CR terminated text string
RANGE,ch,ranging,range	
RESOLU.format	
RESULT,function,number	
RESULT?	multiple integers
REZERO	
SCALE,channel,factor	
SCOPE,phase,channel?	range, trigger, 250 signed integer data values
SCREEN?	multiple data values
SETUP,index,data	
SETUP?	16 lines of ASCII data
SHUNT,channel,resistance	
SMOOTH,type,dynamics	
SPEED,value,window	
START	
STATUS,channel?	range number,range text,over/under/ok
STOP	
SUSPEN,on/off	
USER?	3 CR terminated text strings
VARCON,type	
VERSIO?	datecode,cpu,dsp,fpga,boot
VRMS	
VRMS,PHASE,RMS?	Vrms,Arms,Vdc,Adc,Vac,Aac
VRMS,PHASE,MEAN?	Vrms,Arms,Vmean,Amean,Vff,Aff
VRMS,PHASE,SURGE?	Vrms,Arms,Vpk,Apk,Vcf,Acf,Vsurge,Asurge
WIRING,type	
ZERO	
ZERO,DELETE	
ZOOM,level,d1,d2,d3,d4	
ZOOM?	level,d1,d2,d3,d4

Appendix C – Available character set

The following characters can be selected in text entry mode.
The table is to be read across then down (eg, starting at space and repeatedly pressing NEXT gives ! “ # $ % & ‘ ( ) * etc.)

	!	“	#	$	%	&	‘
(	)	*	+	,	-	.	/
0	1	2	3	4	5	6	7
8	9	:	;	<	=	>	?
@	A	B	C	D	E	F	G
H	I	J	K	L	M	N	O
P	Q	R	S	T	U	V	W
X	Y	Z	[	\	]	^	_
‘	a	b	c	d	e	f	g
h	i	j	k	l	m	n	o
p	q	r	s	t	u	v	w
x	y	z	{	|	}		

Appendix D – Configurable parameters

All parameters can be accessed using the CONFIG command:

CONFIG,*parameter*?
CONFIG,*parameter,data*

Number	Function
	System parameters
1	operating mode
2	digital resolution
4	autozero manual or auto
6	phase convention
7	Frequency lock on/off
8	graph
9	keyboard beep on/off
10	ignore overload
11	low frequency mode
12	window size
13	speed
14	Smoothing
15	Smoothing response
16	baud rate
18	LAN IP address nibble 3
19	LAN IP address nibble 2
20	LAN IP address nibble 1
21	LAN IP address nibble 0
22	Independent ranging
	Input parameters (phase 1)
24	enable channel 1
25	enable channel 2
26	input range channel 1
27	input range channel 2
28	input ranging channel 1
29	input ranging channel 2
30	coupling

32	scale factor channel 1 voltage
33	scale factor channel 2 current
34	external shunt channel 1
35	external shunt channel 2
	General parameters
38	Remote resolution
40	voltage or current frequency reference
	Display parameters
41	display page
42	zoom level
43	function zoomed on 1
44	function zoomed on 2
45	function zoomed on 3
46	function zoomed on 4
47	datalog display type
	Advance parameters
48	manual frequency
49	DFT selectivity
50	program 1-4 direct load
51	language (if installed)
52	frequency filter
53	voltage or current phase reference
	Datalog parameters
54	datalog zoom 1
55	datalog zoom 2
56	datalog zoom 3
57	datalog zoom 4
58	datalog memory type
59	datalog interval
60	datalog graph
	Maths parameters
61	formula
62	argument 1

63	sub argument 1
64	coefficient 1
65	argument 2
66	sub argument 2
67	coefficient 2

Application mode parameters

70	application mode
72	ballast frequency tracking speed
73	low frequency

More maths parameters

74	argument 3
75	sub argument 3
76	coefficient 3
77	argument 4
78	sub argument 4
79	coefficient 4

Power meter parameters

82	wiring configuration
83	integration type
88	integration display
89	sum current average
90	phase 3 frequency reference
91	power factor sign convention
92	VAr sign convention
93	efficiency computation
94	range lock

Harmonic analyser parameters

99	computation mode
100	selected harmonic
101	maximum harmonic
102	harmonic bargraph voltage
103	rated current for TRD
104	harmonic bargraph current

Oscilloscope parameters

106	timebase
107	trigger level
108	pretrigger
109	trigger polarity
110	trigger mode
111	trigger reference
112	trigger phase
113	cursors enable
114	trigger HF reject
115	traces

System parameters

119	zoom 2 high resolution
120	brightness

Auxiliary parameters

122	Auxiliary drive
128	PICS phase offset
129	PICS cycles

Other power parameters

131	2 wattmeter sum computation
132	integrator run time
133	phase to phase mean
134	phase to phase measurement
135	Difference THD

LCR meter parameters

137	parameter
138	measurement
139	Offset

Phase meter parameters

140 voltage peak
144 rectified mean

148 dB offset
150 computation

System parameters

152 RS232 printer enable
154 interface
155 recall with program

Alarm functions

156 alarm 1 data
157 alarm 1 type
158 alarm 1 high threshold
159 alarm 1 low threshold
160 alarm latch
161 alarm sounder
167 alarm 2 data
168 alarm 2 type
169 alarm 2 high threshold
170 alarm 2 low threshold

Input parameters (phase 2)

176 enable channel 3
177 enable channel 4
178 input range channel 3
179 input range channel 4
180 input ranging channel 3
181 input ranging channel 4
182 coupling phase 2
184 scale factor channel 3 voltage
185 scale factor channel 4 current
186 external attenuator channel 3
187 external shunt channel 4

Input parameters (phase 3)

200	enable channel 5
201	enable channel 6
202	input range channel 5
203	input range channel 6
204	input ranging channel 5
205	input ranging channel 6
206	coupling phase 3
208	scale factor channel 5 voltage
209	scale factor channel 6 current
210	external attenuator channel 5
211	external shunt channel 6

Program storage

217	memory
218	data
219	action
220	location

System clock

226	set clock (hrs)
227	set clock (mins)
228	set clock (secs)
229	set date (day)
230	set date (month)
231	set clock (year)

Appendix E – Contact details

Please direct all queries or comments regarding the KinetiQ instrument or manual to:

Newtons4th Ltd.
1 Bede Island Road
Leicester
LE2 7EA
United Kingdom

Tel: (0116) 230 1066
international +44 116 230 1066

Fax: (0116) 230 1061
international +44 116 230 1061

E-mail address: sales@newtons4th.com
office@newtons4th.com

web site: www.newtons4th.com

At Newtons4th Ltd. we have a policy of continuous product improvement and are always keen to hear comments, whether favourable or unfavourable, from users of our products.

An example comment form can be found at the end of this manual – if you have any comments or observations on the product please fill a copy of this form with as much detail as possible then fax or post it to us.

Alternatively send an e-mail with your comments.

PPA5xx/15xx KINETIQ comments

serial number:	main release: dsp release: fpga release: boot release: (press SYS then LEFT)	date:

your contact details:

comments:

detailed description of application or circumstances:

Please post or fax to Newtons4th Ltd.